The Effect of Speed and Seatbelts on Crash Severity Outcome

FINAL REPORT

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Summary of Findings

The presented analysis uses two methods: descriptive, based on tables and statistical, based on regression models. CODES-linked records and all police data collected in 2003-2006 were utilized.

This analysis confirmed that the probability of an injury increases with speed. The seatbelts considerably reduce the probability of injury and this benefit grows with speed because the risk of injury grows more rapidly for unbelted motorists than belted ones. The risk of severe injury typically does not exceed two percent even on high-speed roads. In general, seatbelts are more effective in preventing serious injuries and fatalities. The costs for medical treatment are higher for unbelted motorists, but this difference does not increase considerably with the speed limit on the road where the crash has happened.

There is a strikingly higher benefit for wearing seatbelts on rural roads than on urban roads. Although the benefit of wearing seatbelts in urban areas is present, it is small and does not grow with speed. One explanation of the above result is that seatbelts are less effective at intersections, where the risk injury grows considerably even for belted motorist. County roads have been confirmed to be riskier than other roads when the speed limits are similar. Occupants in larger and heavier vehicles are less exposed to the risk of injury, particularly serious injury, compared to occupants of smaller and lighter vehicles.

Research Question

Although the use of seatbelts is known to save lives, it is not quite obvious under what speed and other road and vehicle conditions this effect is strongest. Greater damage to the vehicle cabin may reduce the effectiveness of seatbelt use in high-speed collisions. On the other hand, wearing a seatbelt, in a medium to low speed collision, may be the difference between being severely injured or killed and having no injury at all. The present study intends to investigate the interaction between these two factors.

The results could help focus speed and seatbelt use enforcement where the greatest benefit from speed reduction and seatbelts is expected.

This analysis uses two methods: (1) descriptive analysis through tabulation of crash distribution by severity for various speed and seatbelt use scenarios and (2) logistic modeling of severe crash outcome under various speed limits, seatbelt use indicators, and additional factors such as the type of road, land development, and vehicle.

Descriptive Analysis

Speed

Available crash data do not include actual vehicle speeds at the time of crashes, so other means are used to estimate realistic ranges of speed. One such means is to assume that speed limits are reasonable proxies for the actual speeds of traffic. Another way would be to aggregate vehicles by the types of maneuvers and vehicle actions just before the crash took place. Both speed limits and vehicle actions are available in the crash database and will be used in this study.

Speed Limits

To gain an understanding of the effect of speed and seatbelt use on the entire population, the posted speed limit of the roadway on which a vehicle was ltraveling at the time of the crash was used as a proxy for the speed at which the vehicle was traveling before impact. It is acknowledged that the actual speeds of drivers may vary based on individual behavior and pre-collision action. However, for an analysis of the population, the posted speed limits were used to define four speed cases:

1. Low speed limit – Vehicle is traveling on a road with a speed limit of less than 35 mph.
2. Moderate speed limit – Vehicle is traveling on a road with a speed limit between 35-44 mph.
3. Moderately high speed limit –Vehicle is traveling on a road with a speed limit between 45-54 mph.
4. High speed limit – Vehicle is traveling on a road with a speed limit of at least 55 mph.

Seatbelt Use and Other Factors

There are many conditions in addition to the investigated speed and seat belt use that may affect the crash outcome severity, including the position of a person in a vehicle, the vehicle size and weight, the location of the vehicle damage, etc. All of these factors must be included in the analysis in order to properly estimate the effect of the two investigated variables.

In an attempt to isolate the effects of seat belt usage and speed, the tabulations presented here focus on the occupants of two vehicle crashes, at intersections, where both vehicles were passenger cars. The interaction between the point of impact of the vehicles and the positions of the occupants are represented by the proximity index defined in Figure 2.

Selectivity Bias

In the early stages of the analyses, it became apparent that we would once more have to deal with the problem of selectivity bias, which is inherent to all CODES data. The problem became more significant when we aggregated the data into abundant subsets,

and the samples in certain cells became too small and biased. As a means to circumvent this problem, our analyses use both the KABCO and MAIS scales, where appropriate, to measure severity. The results of the other CODES research project dealing with imputation of MAIS and injury costs from the crash reports may be used to help with this issue.

Speed Limit, Seatbelt Use, and Severity

At the most basic level, Table 1 presents a distribution of injury severity as a function of speed limits and seatbelt use. To increase the sample sizes and the representativeness, the four speed limit groups were used. Severities were also divided into three groups. For KABCO, the groups include "no injury," "possible and non-incapacitating injuries," and "incapacitating and fatal injuries." It is important to notice that the driver is the only category of not injured occupant present in the crash database. Information about not injured passengers is not collected.

Table 1 shows that, at the KABCO level, the percentage of restrained drivers that are not injured varies from roughly 60% higher than that of drivers not restrained in the low speed limit situation (<35mph), to about 67% higher at medium high speed limits (45-54 mph). The sample sizes were not high enough in the high speed limit conditions.

In a similar fashion, the percentage of unrestrained drivers that suffer incapacitating or fatal injuries is around about 6.6 to 6.9 times larger than the percentage of restrained drivers.

Using the MAIS scale level, that effect was not clear anymore, due to a number of problems. First, the linked sample was much smaller and some speed intervals had very small samples. Also, as it was found during the KABCO-MAIS comparison study, outpatient MAIS levels for severe and fatal injuries tend to be inconsistent. Consequently, the MAIS tables are not included.

Table 1 Percentage of Restrained and Unrestrained Drivers by Severity for each Speed Group

Speed Group	Restraint	KABCO count			KABCO percent (proportional std. dev.)		
		No Injury	Possible / Non-Incap	Incap / Fatal	No Injury	Possible / Non-Incap	Incap / Fatal
<35 MPH	Not Belted	475	461	32	49.07 (1.11)	47.62 (1.11)	3.31 (0.40)
	Belted	35,599	9,532	227	78.48 (0.13)	21.02 (0.13)	0.50 (0.02)
35-44 MPH	Not Belted	381	438	38	44.46 (1.11)	51.11 (1.11)	4.43 (0.46)
	Belted	30,373	10,415	264	73.99 (0.14)	25.37 (0.14)	0.64 (0.03)
45-54 MPH	Not Belted	79	92	10	43.65 (1.11)	50.83 (1.11)	5.52 (0.51)
	Belted	7,364	2,649	83	72.94 (0.14)	26.24 (0.14)	0.82 (0.03)
55+ MPH	Not Belted	5	3	0	62.50 (1.08)	37.50 (1.08)	--
	Belted	389	76	3	83.12 (0.12)	16.24 (0.12)	0.64 (0.03)

Figures 1a and 1b show the different distributions of percentages of belted and unbelted occupants of cars in intersection crashes that fall into each of the three severity classes for each speed group.

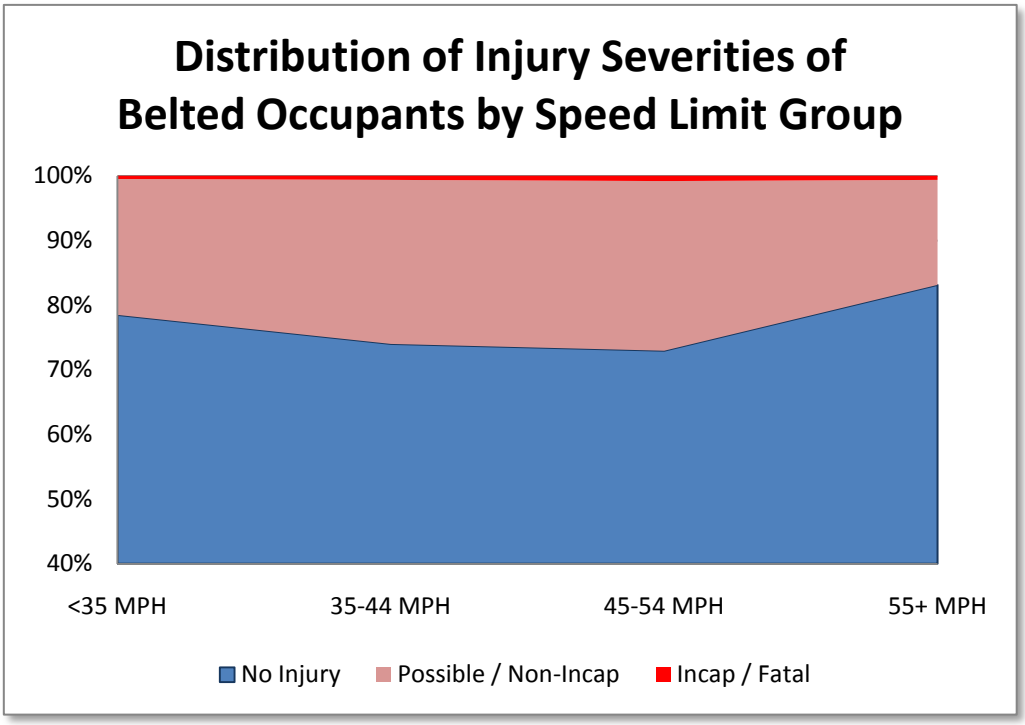


Figure 1a – Distribution of the Injury Severities of Belted Car Occupants by Speed Limit Groups

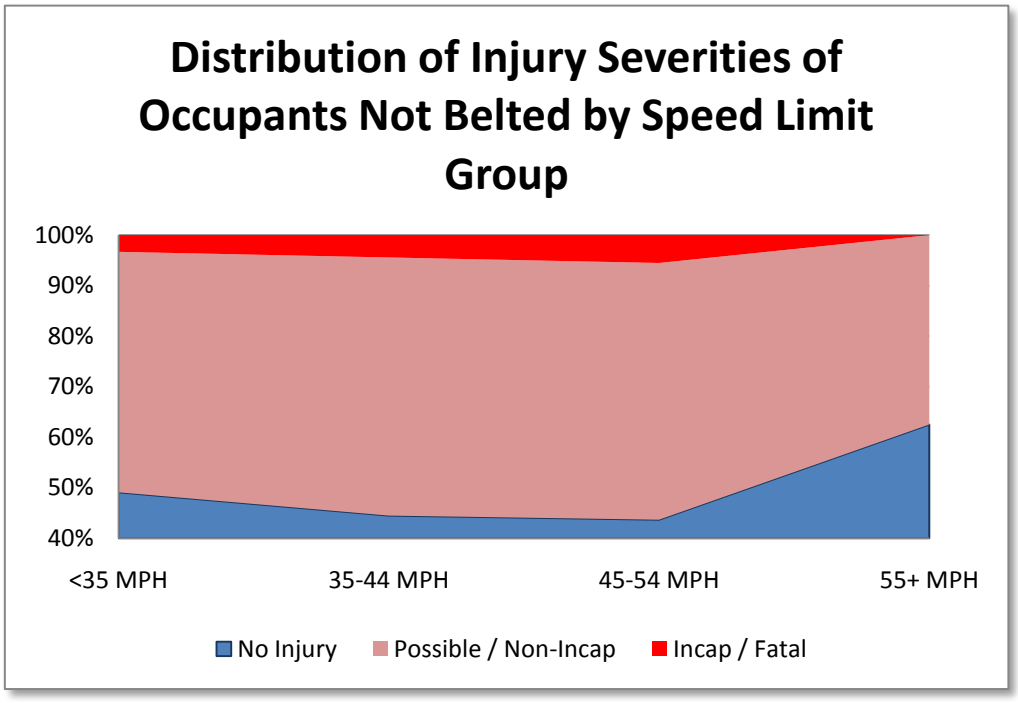


Figure 1b – Distribution of the Injury Severities of Car Occupants Not Belted by Speed Limit Groups

The next step in the research was to start examining the effect of seatbelt usage in association with the effects of speed and the proximity of the occupant to the point of impact in the collision. We also looked at the effect of the minimum distance to a damaged area in the vehicle. The difference being that, while in many circumstances

the maximum amount of energy is dissipated at the time of the first impact, this is not necessarily always the case. So the minimum proximity of the occupant to a damaged area was estimated. As these tables are exclusively for drivers, the occupant position is fixed at the left front of the vehicle. Similar studies for other occupants are underway.

Figure 2 displays the concept of proximity index. Given that the damage area location are expressed as front left, front center, front right, etc., the numbers 1, 2, 3, and 4 express the proximity to the damaged areas, with 1 being the closest.

Occupant Severity

Table 2 illustrates how the effect of the collision is diminished as the point of impact is farther away from the position of the driver. This table does not yet show the impact of speed. As the proximity index increases from 1 (closest) to 4 (farthest), the percentages of both belted and non-belted occupants who are not injured, using the KABCO scale, increase. Simultaneously, the percentages of drivers with possible and non-incapacitating injuries, as well as those with incapacitating and fatal injuries, decrease as the index increases. It is important to notice that the percentage of drivers uninjured when belted at maximum proximity to the point of impact is still higher than the percentage of drivers uninjured when unbelted at maximum distance from the impact. The relationship between seatbelt use, injury severity and the proximity index can be visualized in Figures 3a and 3b.

Table 2 – Influence of the distance from point of impact for occupants.

Restraint	Minimum Proximity	KABCO count			KABCO percent (proportional standard deviation)		
		No Injury	Possible / Non-Incap	Incap / Fatal	No Injury	Possible / Non-Incap	Incap / Fatal
Belted	1	43,279	14,770	455	74.0 (0.14)	25.2 (0.14)	0.8 (0.03)
	2	23,917	6,651	113	78.0 (0.13)	21.7 (0.13)	0.4 (0.02)
	3	6,529	1,251	9	83.8 (0.12)	16.1 (0.12)	0.1 (0.01)
Not Belted	1	633	732	66	44.2 (1.11)	51.2 (1.11)	4.6 (0.47)
	2	231	233	13	48.4 (1.11)	48.8 (1.11)	2.7 (0.36)
	3	76	29	1	71.7 (1.00)	27.4 (0.99)	0.9 (0.22)

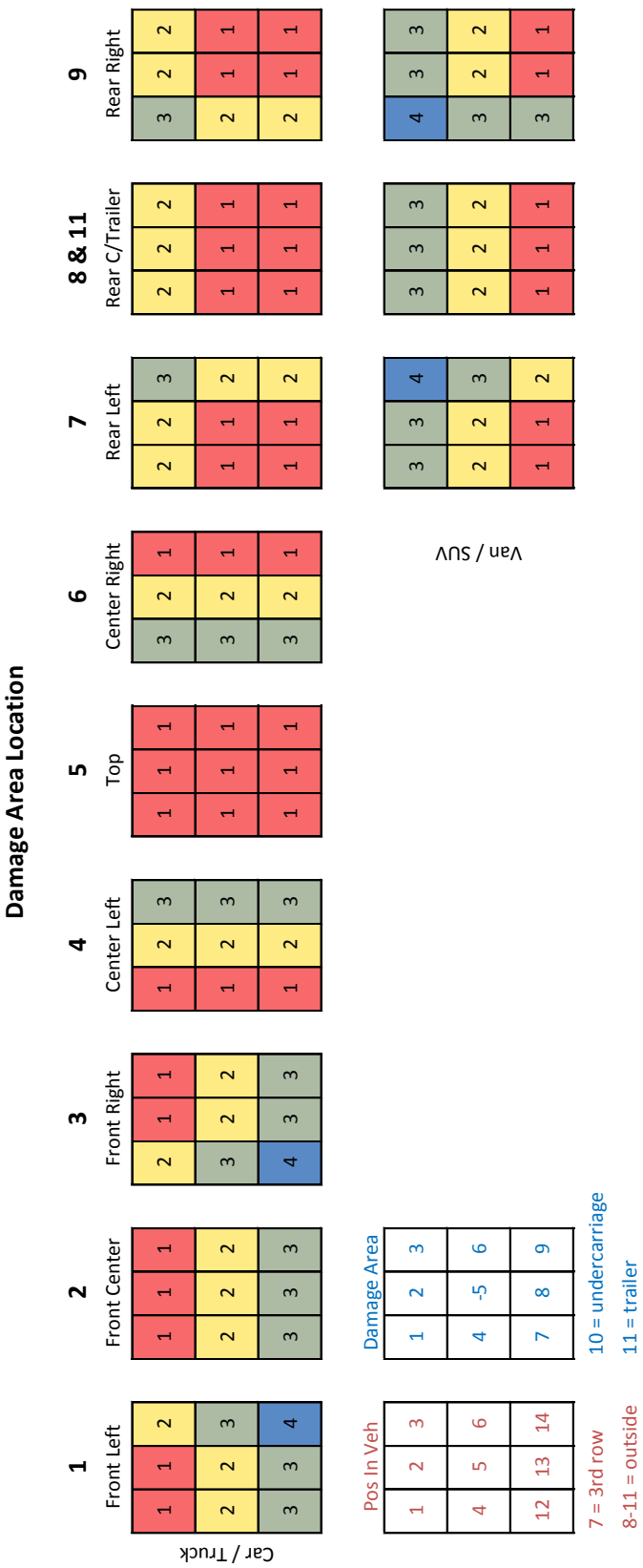


Figure 2 – Proximity Index – Reflects Proximity to the Impact Area of the Vehicle

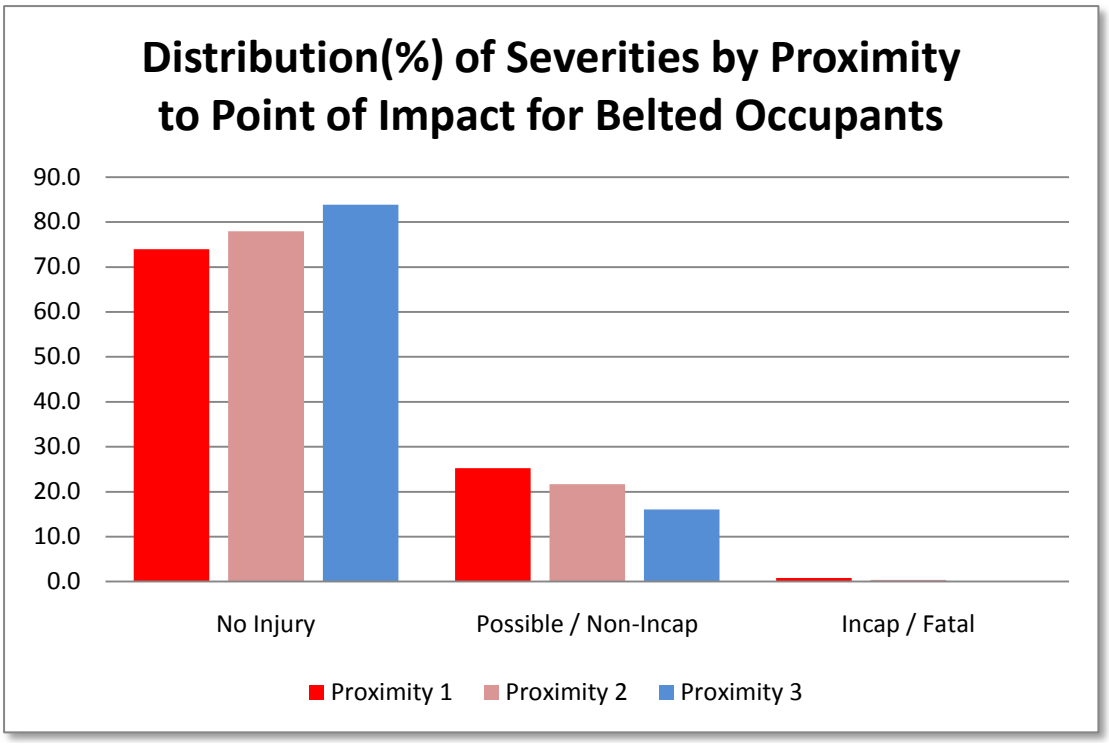


Figure 3a – Proximity Index Effect on the Severity of Belted Occupants

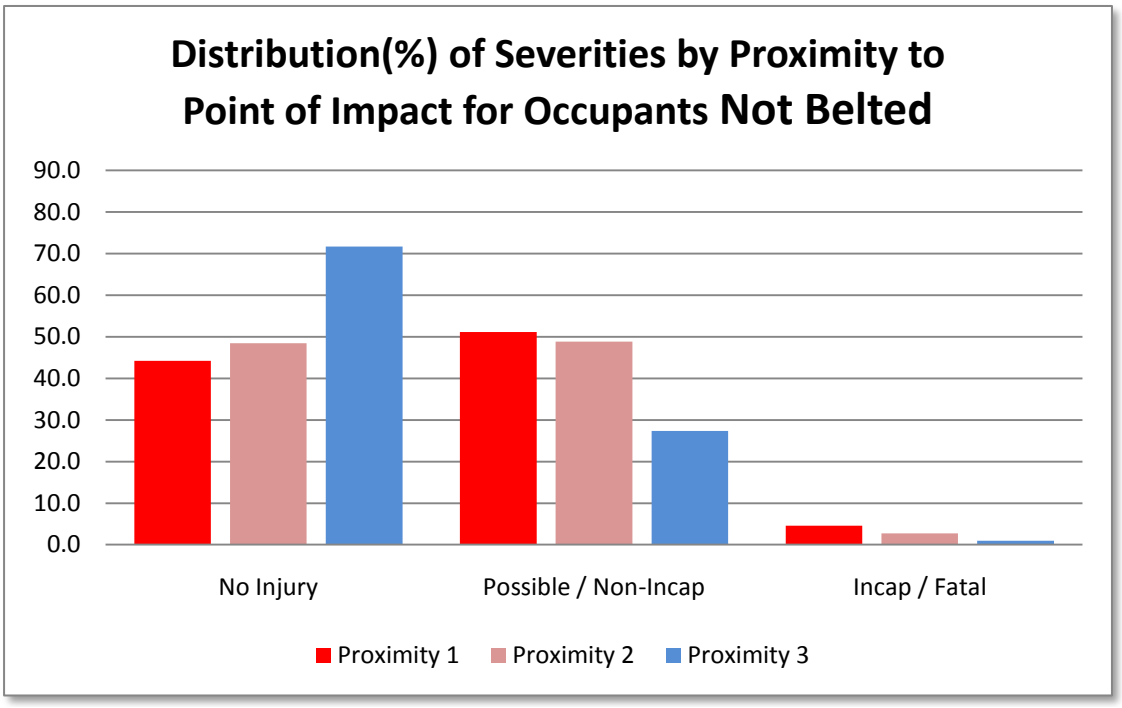


Figure 3b – Proximity Index Effect on the Severity of Occupants Not Belted

The introduction of speed as a factor brings new light to the problem. Examining the percentage distributions in Table 3, one sees that the trends described in past tables occur up to moderately high speed limits. At higher speeds, the sample sizes were too small to allow the comparison patterns for restrained and unrestrained occupants.

Nevertheless, as it is shown in Figures 4a and 4b, even for low and moderate speed limits, the percentage of unbelted occupants that suffer possible and non-incapacitating injuries remains between 2.3 and 1.6 times higher than those of belted occupants at Proximity 1 to Proximity 3 respectively. And the percentage of unbelted occupants suffering incapacitating or fatal injuries is between 7.8 and 13 times higher than those of belted occupants, for proximities 1 to 3. On the other hand, for belted drivers, even at higher speeds, greater distances from the point of impact still increase the chances for no injuries, possible and non-incapacitating injuries. These patterns seem to be an excellent reason to promote the use of seatbelts.

Table 3 – Influence of Restraint Use, Speed and Proximity to the Point of Impact on Injury Severity

Restraint	Minimum Proximity	Speed Group	KABCO count			KABCO percent		
			No Injury	Possible / Non-Incap	Incap / Fatal	No Injury	Possible / Non-Incap	Incap / Fatal
Belted	proximity 1	<35 MPH	21,106	6,314	185	76.5	22.9	0.7
		35-44 MPH	17,829	6,755	209	71.9	27.3	0.8
		45-54 MPH	4,148	1,657	61	70.7	28.3	1.0
		55+ MPH	196	44	0	81.7	18.3	0.0
	proximity 2	<35 MPH	11,046	2,626	37	80.6	19.2	0.3
		35-44 MPH	10,011	3,097	51	76.1	23.5	0.4
		45-54 MPH	2,692	898	22	74.5	24.9	0.6
		55+ MPH	168	30	3	83.6	14.9	1.5
	proximity 3	<35 MPH	3,447	592	5	85.2	14.6	0.1
		35-44 MPH	2,533	563	4	81.7	18.2	0.1
		45-54 MPH	524	94	0	84.8	15.2	0.0
		55+ MPH	25	2	0	92.6	7.4	0.0
Not Belted	proximity 1	35-44 MPH	254	322	32	41.8	53.0	5.3
		45-54 MPH	63	71	9	44.1	49.7	6.3
		55+ MPH	3	3	0	50.0	50.0	0.0
		<35 MPH	313	336	25	46.4	49.9	3.7
	proximity 2	<35 MPH	116	110	6	50.0	47.4	2.6
		35-44 MPH	100	106	6	47.2	50.0	2.8
		45-54 MPH	13	17	1	41.9	54.8	3.2
		55+ MPH	2	0	0	100.0	0.0	0.0
	proximity 3	<35 MPH	46	15	1	74.2	24.2	1.6
		35-44 MPH	27	10	0	73.0	27.0	0.0
		45-54 MPH	3	4	0	42.9	57.1	0.0
		55+ MPH	0	0	0	-	-	-

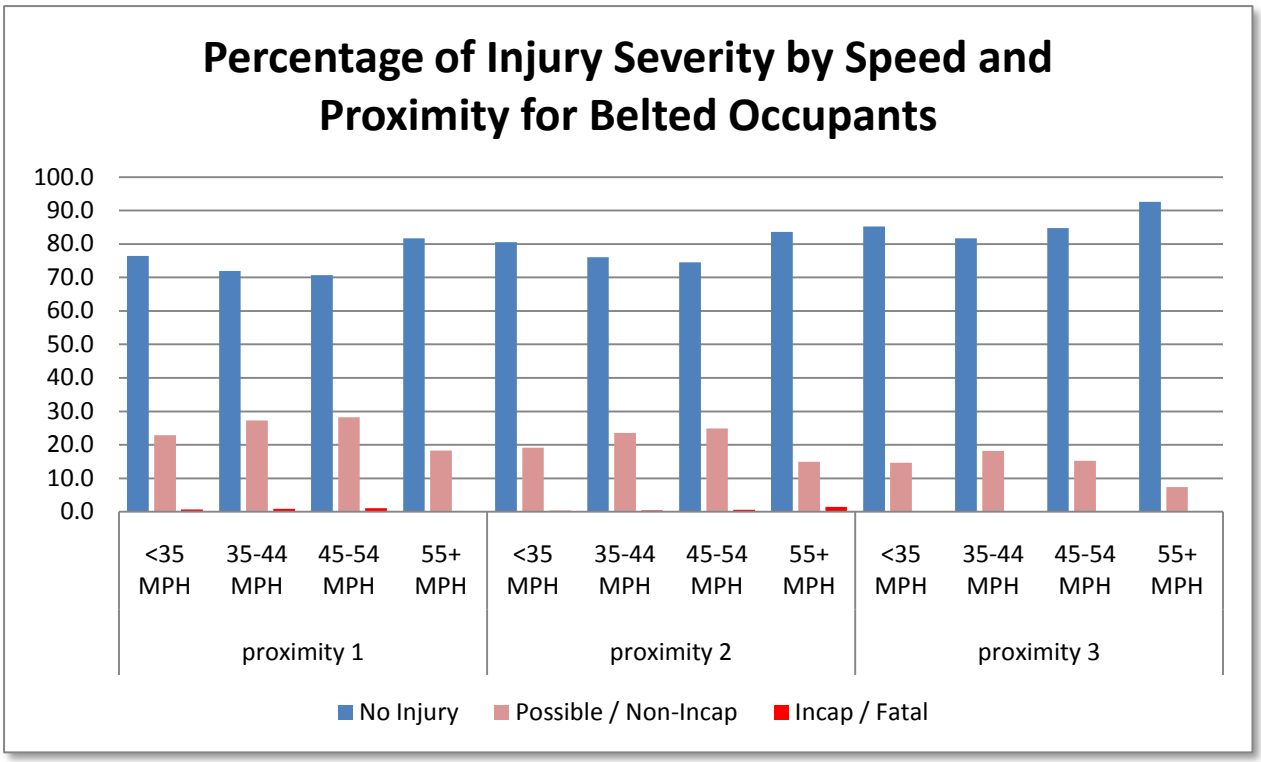


Figure 4a – Proximity Index and Speed Effect on the Severity of Belted Occupants

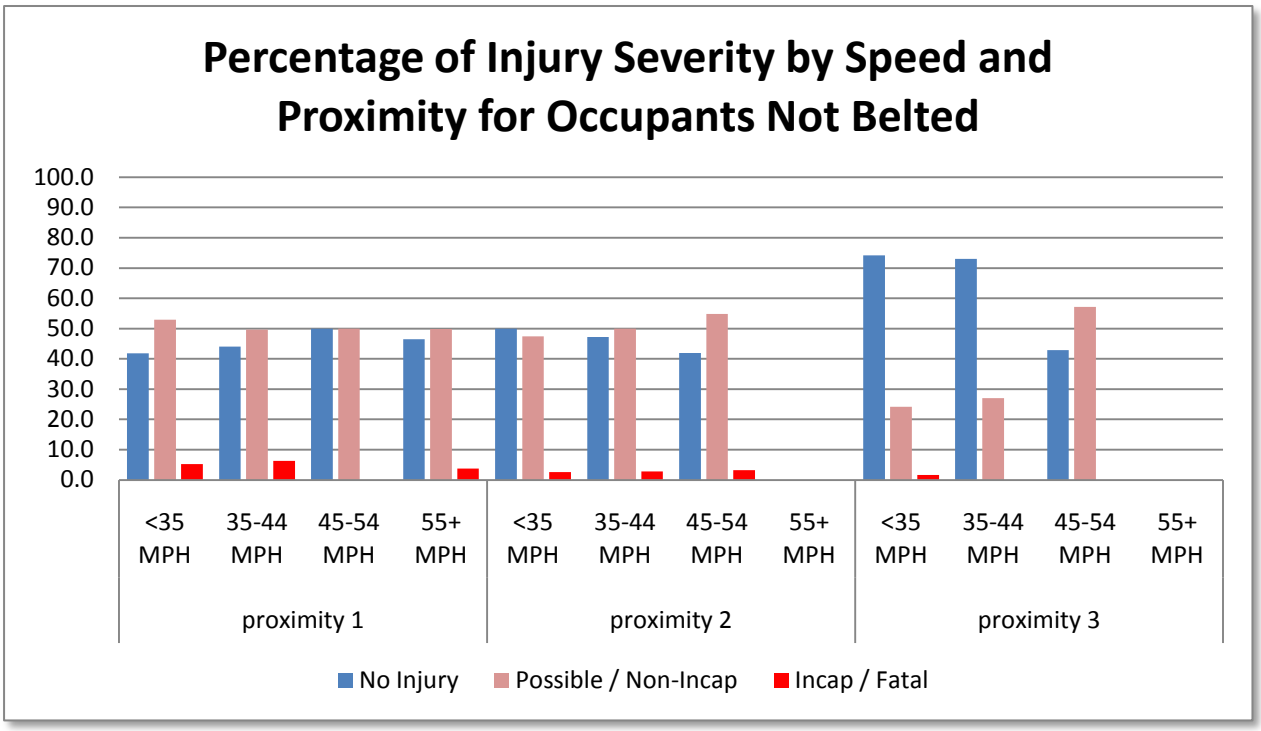


Figure 4b – Proximity Index and Speed Effect on the Severity of Occupants Not Belted

Hospital Charges

The linkage of crash data to hospital records allows us to observe the hospital charges incurred by the victims of the crashes discussed so far. It can be expected that charges for the treatment of similar injuries may vary regionally, and even among hospitals in the same region. Other extraneous conditions, like the patient's type of health insurance, or lack thereof, also may affect the final charges. Nevertheless, patterns should still be noticeable.

Figure 5 illustrates the annual median hospital charges for both restrained and unrestrained occupants as a function of the speed limits. Curiously, annual charges seem to show a strong inflationary growth for unrestrained occupants, whereas a milder increase was observed for the restrained population. As previously noted, the sample size for linked unrestrained occupants at medium high and high speed limits were small or missing.

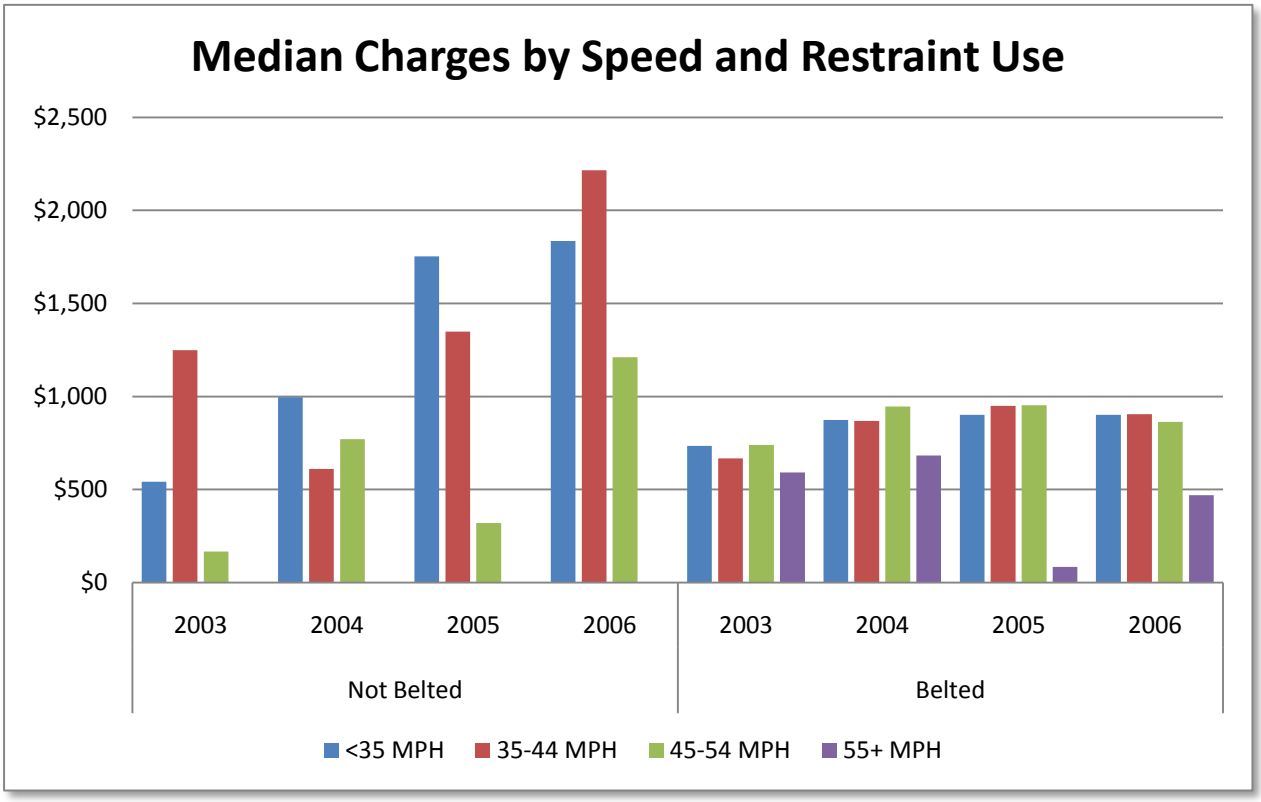


Figure 5 – Median Hospital Charges as Function of Restraint Use and Speed Limit

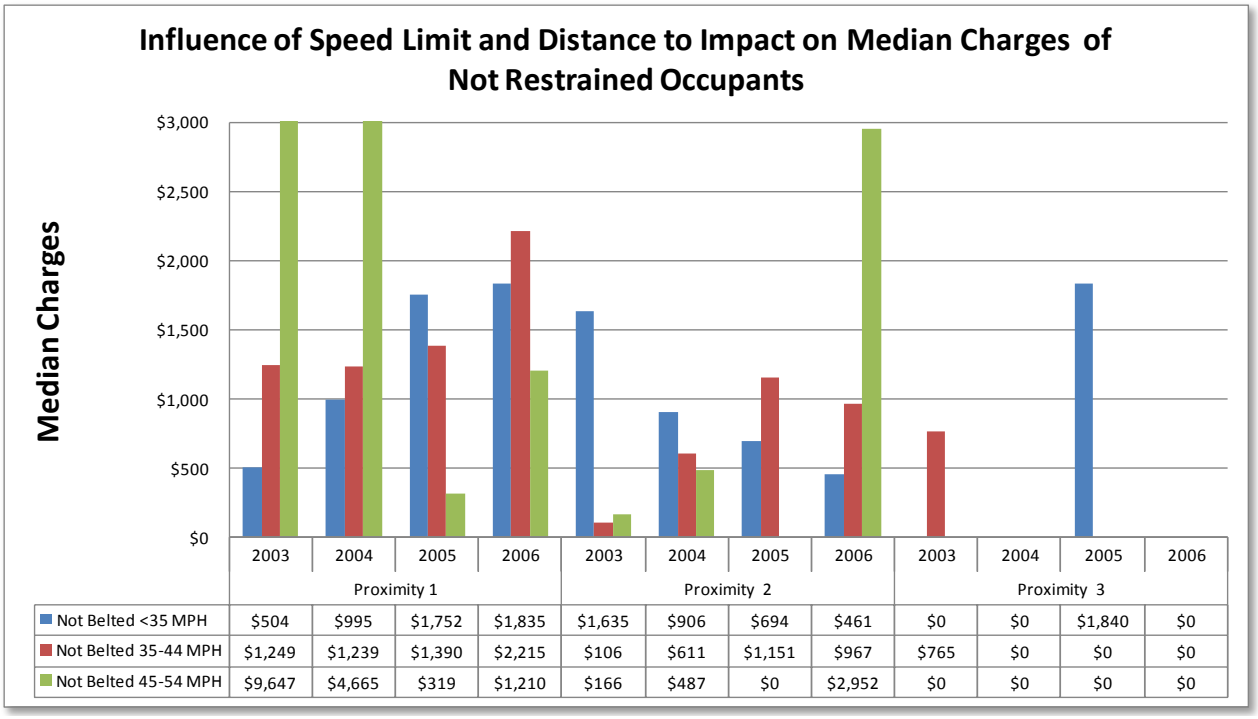
Table 4, along with Figures 6a and 6b, re-introduce the influence of the proximity factor to the pattern represented in Figure 5. Table 4 breaks down the median hospital charges by proximity, year, and restraint use. The information was limited by the small number of observations for the higher speed groups and proximity category 3. There was no clear trend between speed groups for either the different proximity or restraint use categories. However, it was clear that the median charges for belted occupants were less than for unbelted. As was shown in Figure 5, the increase in charges by year within each proximity and restraint use group suggests the effect of inflation on the data. Finally, it was expected that an increase in proximity,

representing an occupant's minimum distance from the point of impact, corresponds to a decrease in hospital charges. This hypothesis was supported by the data: for each speed group, the average costs decreased from Proximity 1 to Proximity 2. There was also a decrease between Proximity 2 and 3 for belted occupants in the lower speed categories. There were not enough observations to draw any conclusions for unbelted occupants with Proximity 3.

Table 4 – Influence of Restraint Use, Speed, and Proximity to the Point of Impact on Injury Severity on Median Hospital Charges

Median Hospital Charges								
	Year	Not Belted			Belted			
		<35 MPH	35-44 MPH	45-54 MPH	<35 MPH	35-44 MPH	45-54 MPH	55+ MPH
Proximity 1	**2003**	$504	$1,249	$9,647	$736	$619	$734	$951
	2004	$995	$1,239	$4,665	$928	$861	$957	$682
	2005	$1,752	$1,390	$319	$912	$994	$911	$84
	2006	$1,835	$2,215	$1,210	$959	$990	$895	$377
Proximity 2	**2003**	$1,635	$106	$166	$727	$753	$803	$391
	2004	$906	$611	$487	$831	$939	$691	$958
	2005	$694	$1,151	.	$737	$912	$1,001	.
	2006	$461	$967	$2,952	$761	$718	$777	$1,215
Proximity 3	**2003**	.	$765	.	$698	$687	$502	$669
	2004	.	.	.	$644	$612	$693	$138
	2005	$1,840	.	.	$707	$507		.
	2006	.	.	.	$497	$613	$735	.

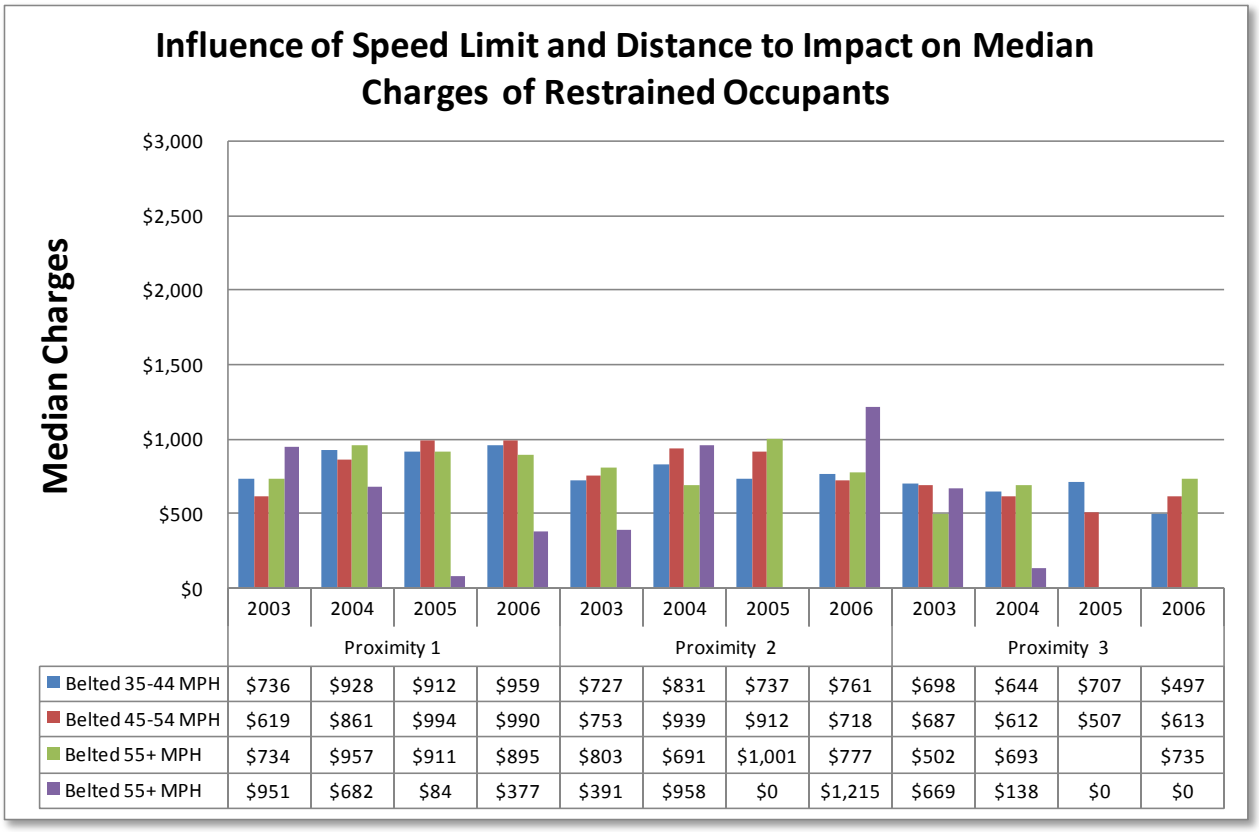
Figure 6a shows the breakdown of not belted occupants by speed group and proximity. The graph has been limited to a maximum charge of $3,000; however, the not belted occupants of Proximity 1 and speed 45-55 MPH have median charges over $9,600 in 2003. The median hospital charges were much larger for not belted occupants of Proximity 1 than for Proximity 2. Again, it can be seen that conclusions cannot be drawn for Proximity 3 due to a lack of data. The overall annual increase in charges seen in Figure 5 is also visible in Figure 6a for both Proximity 1 and Proximity 2.



	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006
	Proximity 1				Proximity 2				Proximity 3			
Not Belted <35 MPH	$504	$995	$1,752	$1,835	$1,635	$906	$694	$461	$0	$0	$1,840	$0
Not Belted 35-44 MPH	$1,249	$1,239	$1,390	$2,215	$106	$611	$1,151	$967	$765	$0	$0	$0
Not Belted 45-54 MPH	$9,647	$4,665	$319	$1,210	$166	$487	$0	$2,952	$0	$0	$0	$0

Figure 6a – Influence of Speed Limit and Proximity on the Median Charges of Occupants Not Restrained.

Figure 6b shows the median charges by year and proximity for belted occupants. The effect of restraint use on reducing the severity of a crash can be seen by the low overall charges for belted occupants compared to those not belted. In Figure 6b, all of the median charges around or below $1,000. There was not a clear trend between years to suggest the influence of inflation on the data. There was a slight decrease in median charges as the proximity increases. However, seatbelt use seems to reduce the overall charges, so this decrease was not as clear as it was for not belted occupants.



	Proximity 1				Proximity 2				Proximity 3			
	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006
Belted 35-44 MPH	$736	$928	$912	$959	$727	$831	$737	$761	$698	$644	$707	$497
Belted 45-54 MPH	$619	$861	$994	$990	$753	$939	$912	$718	$687	$612	$507	$613
Belted 55+ MPH	$734	$957	$911	$895	$803	$691	$1,001	$777	$502	$693		$735
Belted 55+ MPH	$951	$682	$84	$377	$391	$958	$0	$1,215	$669	$138	$0	$0

Figure 6b – Influence of Speed Limit and Proximity on the Median Charges of Restrained Occupants.

Logistic Models

The impact of seatbelts under different speed conditions determined by speed limit was investigated using logistic regression. Logistic regression models of the form: $P = \frac{\exp(\boldsymbol{BX})}{1+\exp(\boldsymbol{BX})}$ with $\boldsymbol{BX} = b_0 + b_1 x_1 + \cdots + b_n x_n$ has been used where $x_0 \ldots x_n$ are variable representing speed conditions and seatbelt use and $b_0, \ldots b_n$ are model parameters estimated from the CODES and Indiana State Police data.

The P value is the probability that a certain injury outcome happens under conditions X given that crash has occurred. In our project, we have used four different measures of injury severity:

(1) MAIS value 3 or higher, which indicates severe or critical injury,
(2) Total hospital charges as an alternative measure of injury severity with the assumption that they grow with the severity level,
(3) KABCO value higher than O, which indicates any injury detectable at the crash scene,
(4) KABCO value K or A, which indicates fatality or incapacitating injury.

The statistical package SAS was used. The results reported by the SAS package are presented in Appendix A and summarized in Figures 7-19 following this discussion.

The speed limit was selected as the most plausible condition that determines the prevailing speeds on roads. This information is collected by police officers at the crash scene and coded in the ISP crash dataset. The following speed limits reported in the database are used: 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, and 70 miles per hour. In some cases, such as interstate roads only higher values were used. The seatbelt use is also coded in the crash data for individuals involved in a crash. Consequently, we have used a set of binary variables X representing the speed limit jointly with the seatbelt use. For example, SL45*NSeatB = 1 indicates that a person recorded in the police database did not use a seatbelts (No Seatbelt) during a crash on a road with a speed limit (Speed Limit) of 45 miles per hour. In another example, SL65*SeatB = 1 indicates that a person recorded in the database used a seatbelt (Seatbelt) during a crash on a road with a speed limit of 65 miles per hour. Corresponding parameters **B** are reported in Appendix A.

Figures 7 and Figures 9-19 present the probability of injury for a person involved in a crash on a road with a given speed limit and in two cases: (1) Belted, and (2) Not Belted. Only Figure 8 uses the hospital charges as a measure of crash severity.

Speed Effect

In almost all investigated cases, the probability of an injury increases with speed. This increases is observed regardless of whether a person is belted or not, although the growth rate is faster in the case of not belted individuals. In the case of very high speeds 60-70 miles per hour only, the increase is not obvious and in some cases reverses (see Figure 10, cars in rural areas). This result should be attributed to the liberal and forgiving design of interstate roads where such speed limits are allowed. In several cases, the probability function of speed exhibits strong local perturbations such as in Figure 7, upper graph, speeds 55-70 mi/h. This is most likely the effect a

small number of observations and, consequently, unreliable estimation of the average tendency. The same data aggregated into three speed limit classes (Figure 1, bottom graph) show the expected tendency seen in other figures more clearly.

Seatbelts Effect

It is apparent from most of the figures, that seatbelts considerably reduce the probability of injury. This benefit tends to grow with speed. There are also other factors that magnify or reduce this benefit, which are discussed in the following section. The hospital charges presented in Figure 8 exhibit behaviors similar to the probability of injury. The hospital charges for unbelted patients do not grow much faster than for those who used seatbelts.

Selectivity Bias

CODES data include those individuals whose police records could be linked with hospital records. This link exists only if a person was taken to a hospital for examination or sought medical assistance later. This mechanism leads to overrepresentation of severe injuries in linked data compared to the police records. Demonstration of this effect can be seen in Figure 9. The proportion of injuries according to an on-scene evaluation is approximately three times higher in CODES data than in the police data. This might not be a big problem, but it seems that the growing benefit from using seatbelts on roads with higher speed limits is distorted in the CODES data, which no longer appears to be significant. Fortunately, this distortion decreases for the most severe injuries (Figure 10). The proportion of severe injuries to all cases is still two-three times higher in the CODES data than in the police data though. Another issue to deal with was a smaller sample, which makes detecting safety effects more difficult. Therefore, the remainder of this discussion utilizes the entire police dataset and the KBCO scale instead of MAIS.

Rural vs. Urban Areas

These analyses were performed for passenger cars only to eliminate the effect of trucks. Trucks appear at higher percentage on high-speed roads and in rural areas and might obscure the results. Figure 11 shows a striking difference between seatbelt effectiveness in rural and urban areas. The risk of an injury when wearing seatbelts (including minor injuries) is similar in both areas, but the risk of injury grows more rapidly with the speed limit in rural areas. It is also striking that wearing seatbelts is much more effective in preventing severe injuries than minor injuries (Figures 11 and 12). In this case, the benefit of wearing seatbelts in urban areas is clear, although small, and it does not grow with speed.

Intersections

Seatbelts at intersections are not as effective as on road segments (Figure 13). This might be one of explanations why urban areas with many intersections and many intersection crashes do not benefit as much from seatbelts as rural areas. The character of collisions at intersections with impacts possible from any direction apparently reduces the ability of seatbelts to prevent injury.

Road Class

Comparison of the probabilities of injury and severe injury between county roads, state roads, and interstate roads (Figures 14 and 15) reveals higher risk of injury on a lower class of road for the same speed. This was expected as the lower class roads

have lower design standards and are less forgiving than higher class roads. It is also quite likely, confirmed with the federal-funded project on Rational Speed Limits, that users of county roads tend to ignore speed limits that they consider to be too low. The discrepancy in the risk of severe injury is even appealing. Eight percent of people not wearing seatbelts during a collision on county roads with a speed limit of 40 miles per hour are seriously injured compared to only three percent of individuals on state roads (same speed limit, not wearing seatbelts). In both cases, wearing seatbelts would reduce this risk to 1-1.5 percent.

Vehicle Size and Weight

The results confirm that, in general, larger and heavier vehicles help prevent injury and serious injury (Figures 16-19). The risk of injury for unbelted individuals grows in almost all cases in proportion to the speed limit and in some cases even faster while the belted individuals' risk grows much slower and in some cases reaches a fixed level. The probability of injury, including severe injury, is much smaller for truck and bus occupants than other vehicles, particularly when the occupants are belted. At 50 miles per hour (speed limit), the risk of severe injury even for the unbelted occupant of a heavy vehicle is only 2 percent compared to 6-8 percent for occupants of lighter and smaller vehicles.

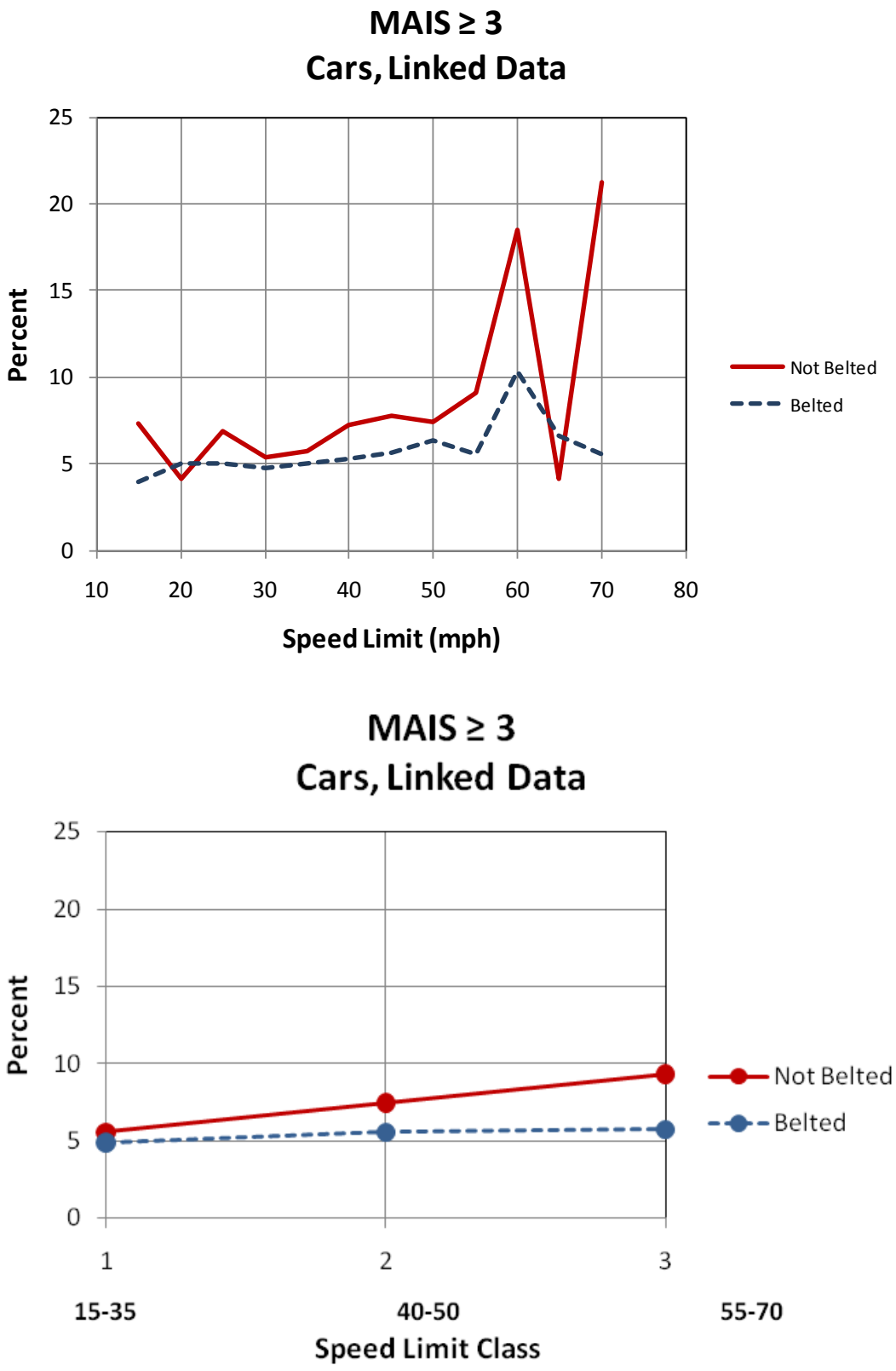
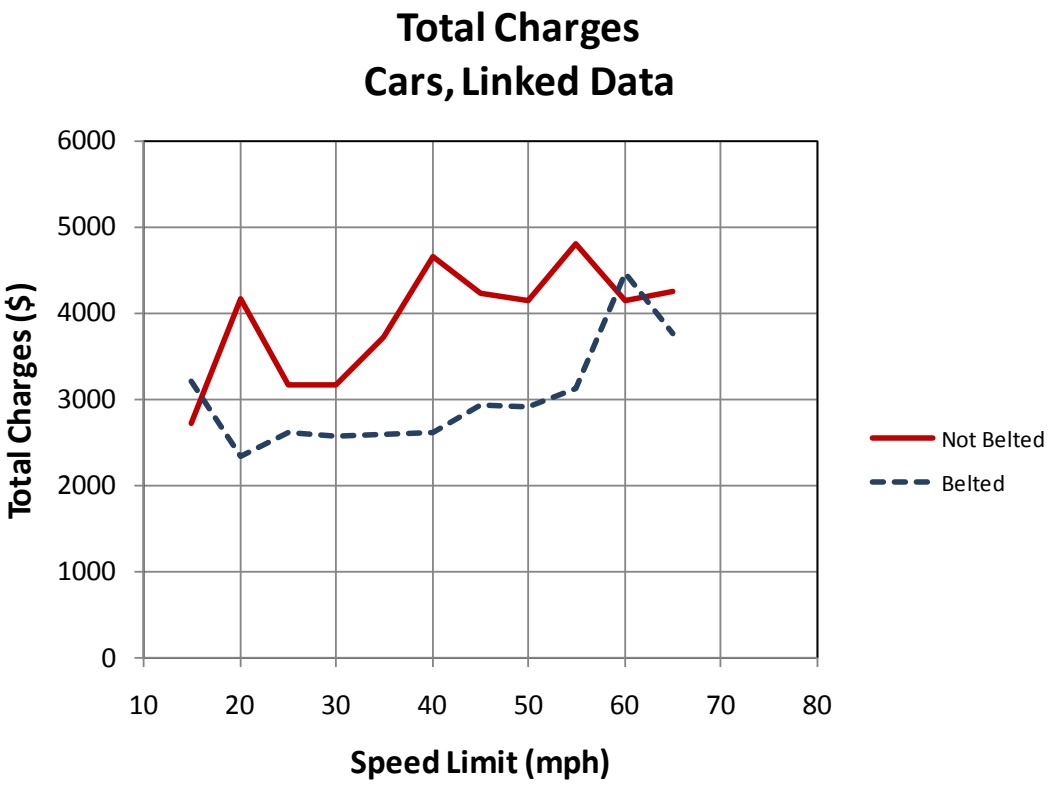


Figure 7 Speed and seatbelts impact on percent of severe and critical injuries of car occupants measured with MAIS ≥ 3, 2003-2006 CODES data



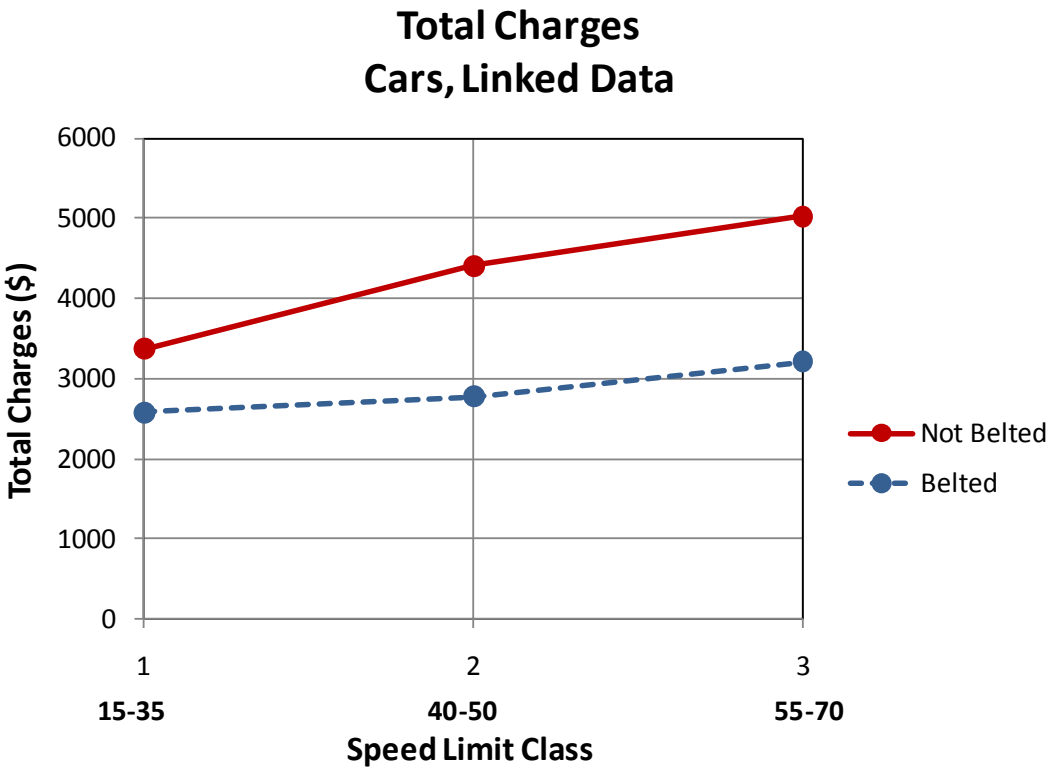
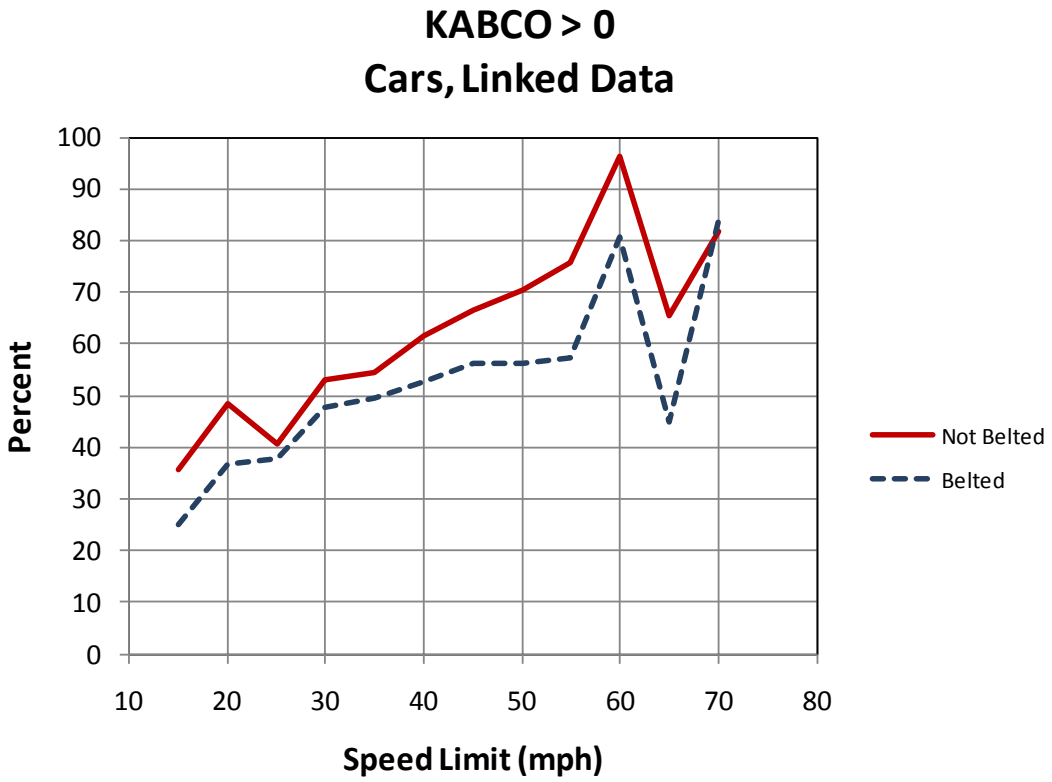


Figure 8 Speed and seatbelts impact on hospital charges for car occupants, 2003-2006 CODES data



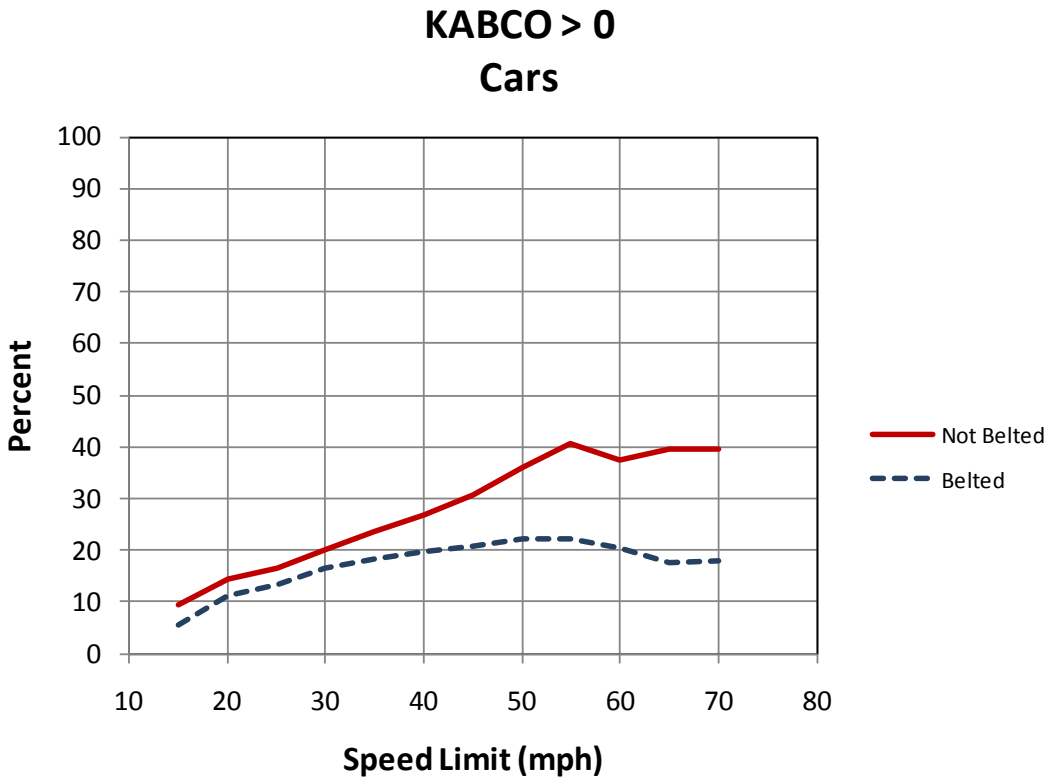


Figure 9 Selectivity bias in the speed and seatbelts impact estimate present in the CODES data, injuries reported in the 2003-2006 Police crash database

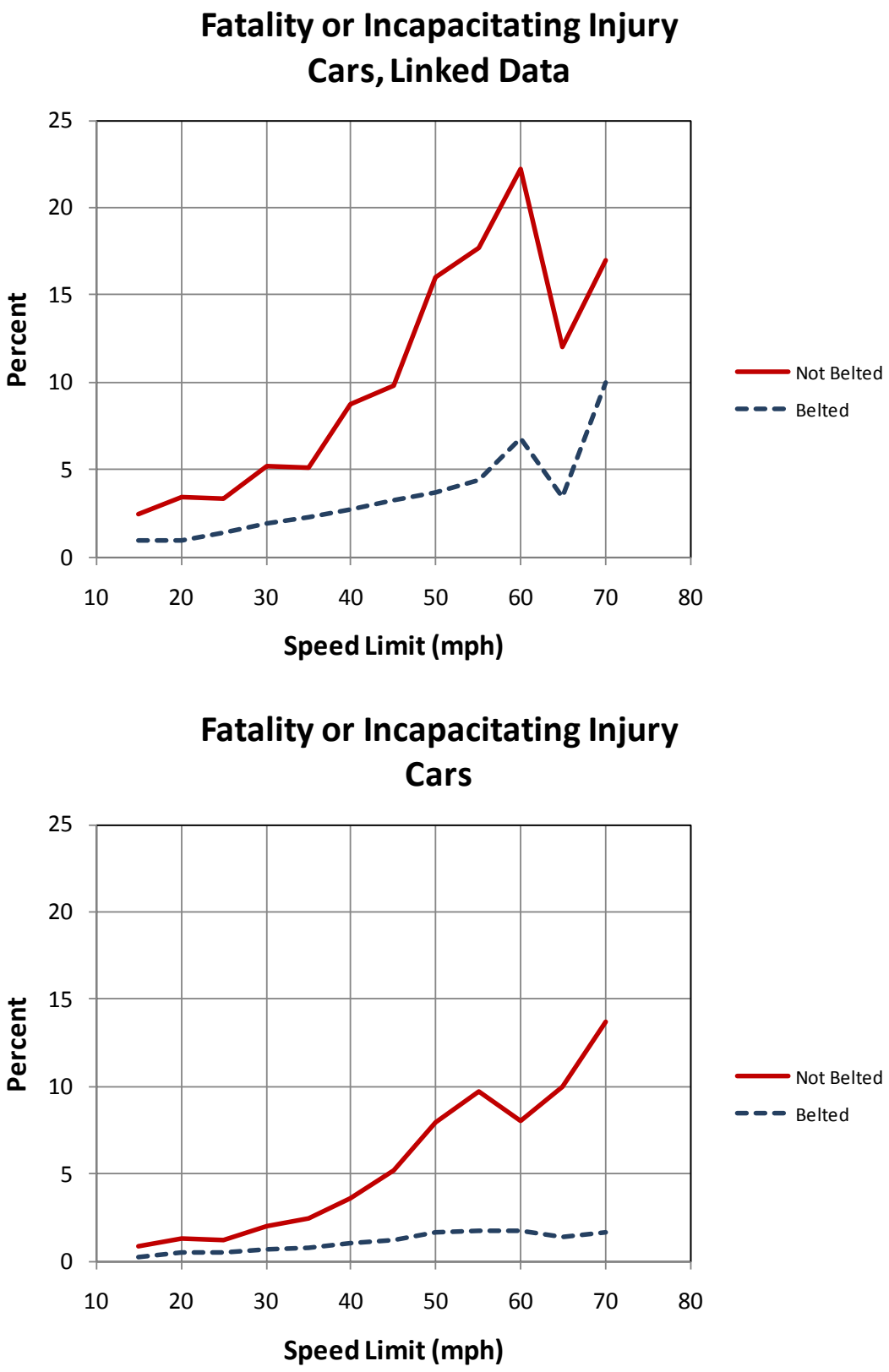


Figure 10 Selectivity bias in the speed and seatbelts impact estimate (severe injuries) present in the CODES data, 2003-2006 Police crash database

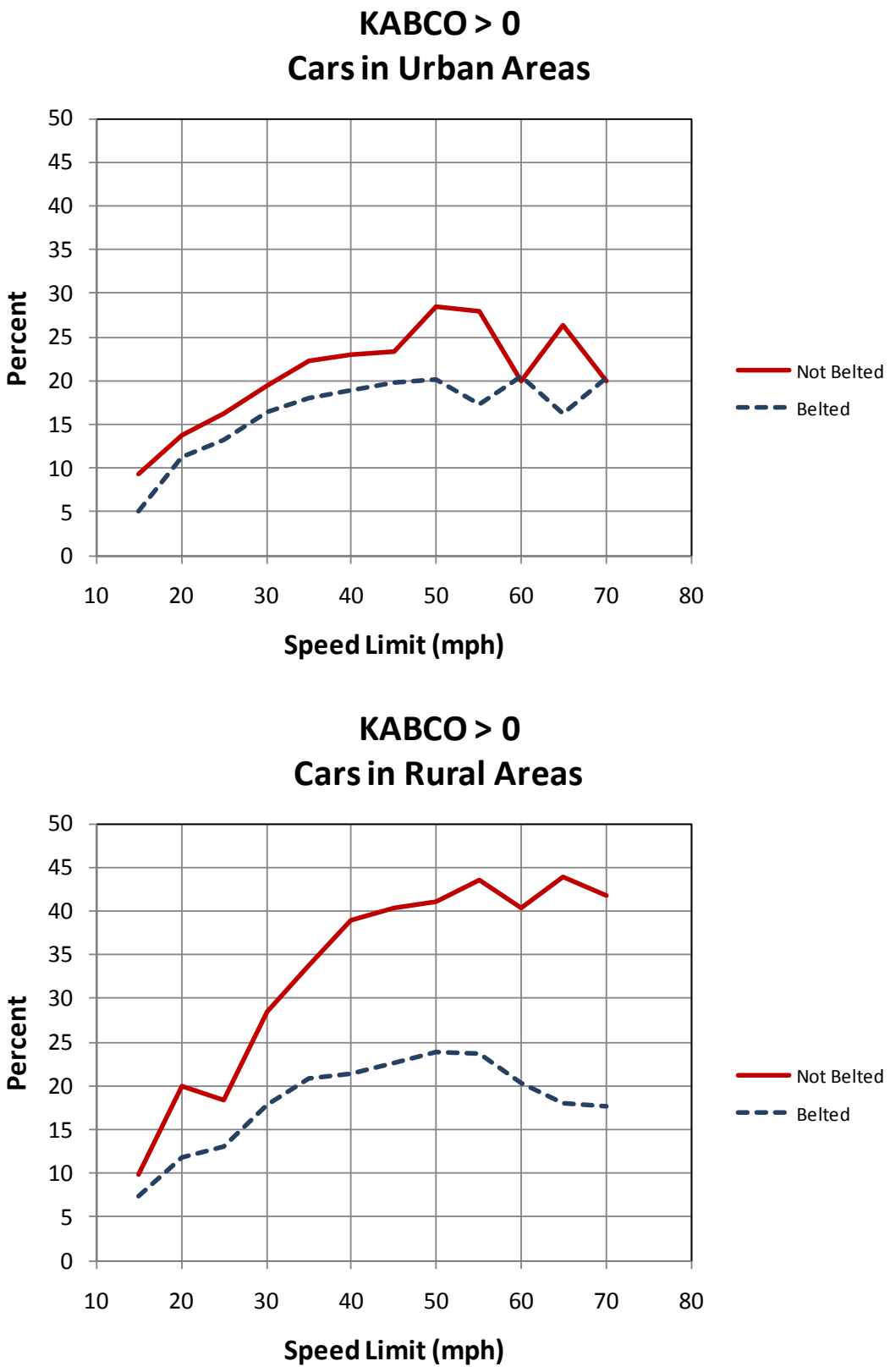
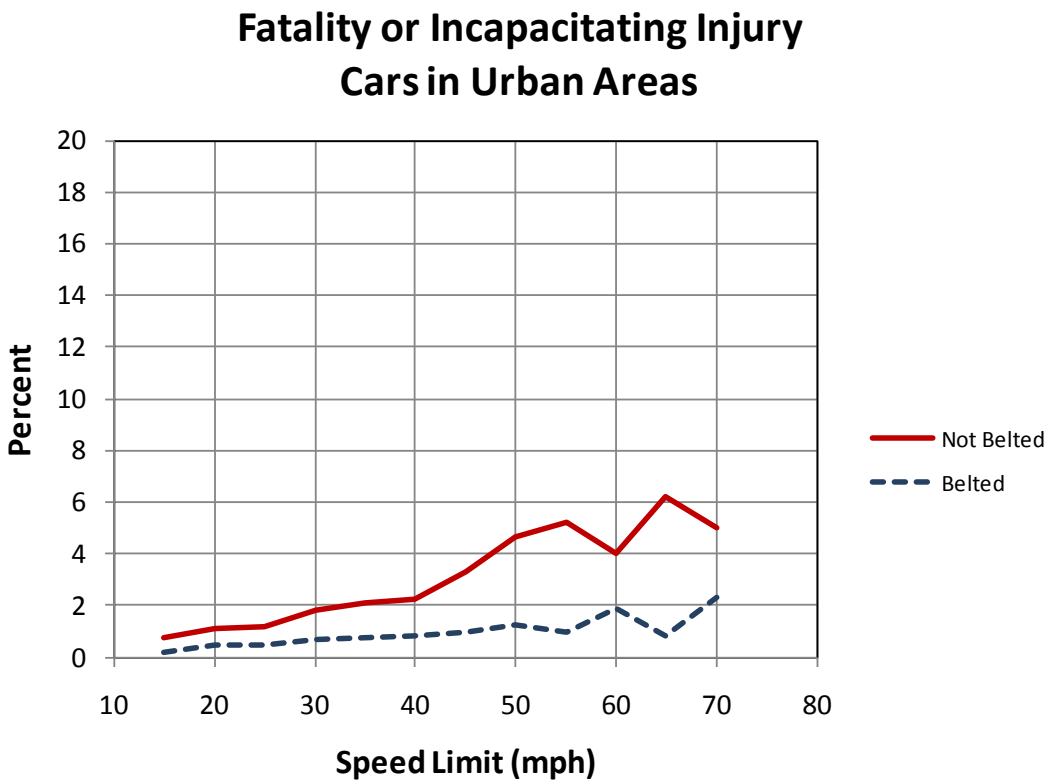


Figure 11 Speed and seatbelts impact on percent of injuries of car occupants in urban and rural areas, 2003-2006 Police data



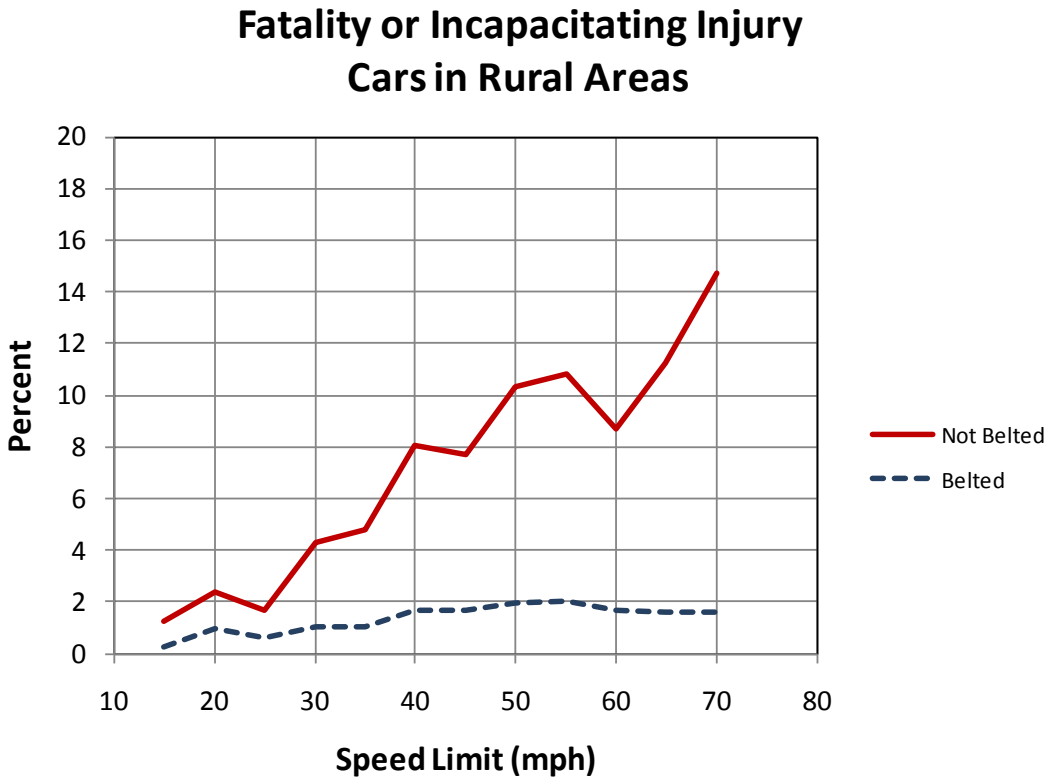


Figure 12 Speed and seatbelts impact on percent of severe injuries of car occupants in urban and rural areas, 2003-2006 Police data

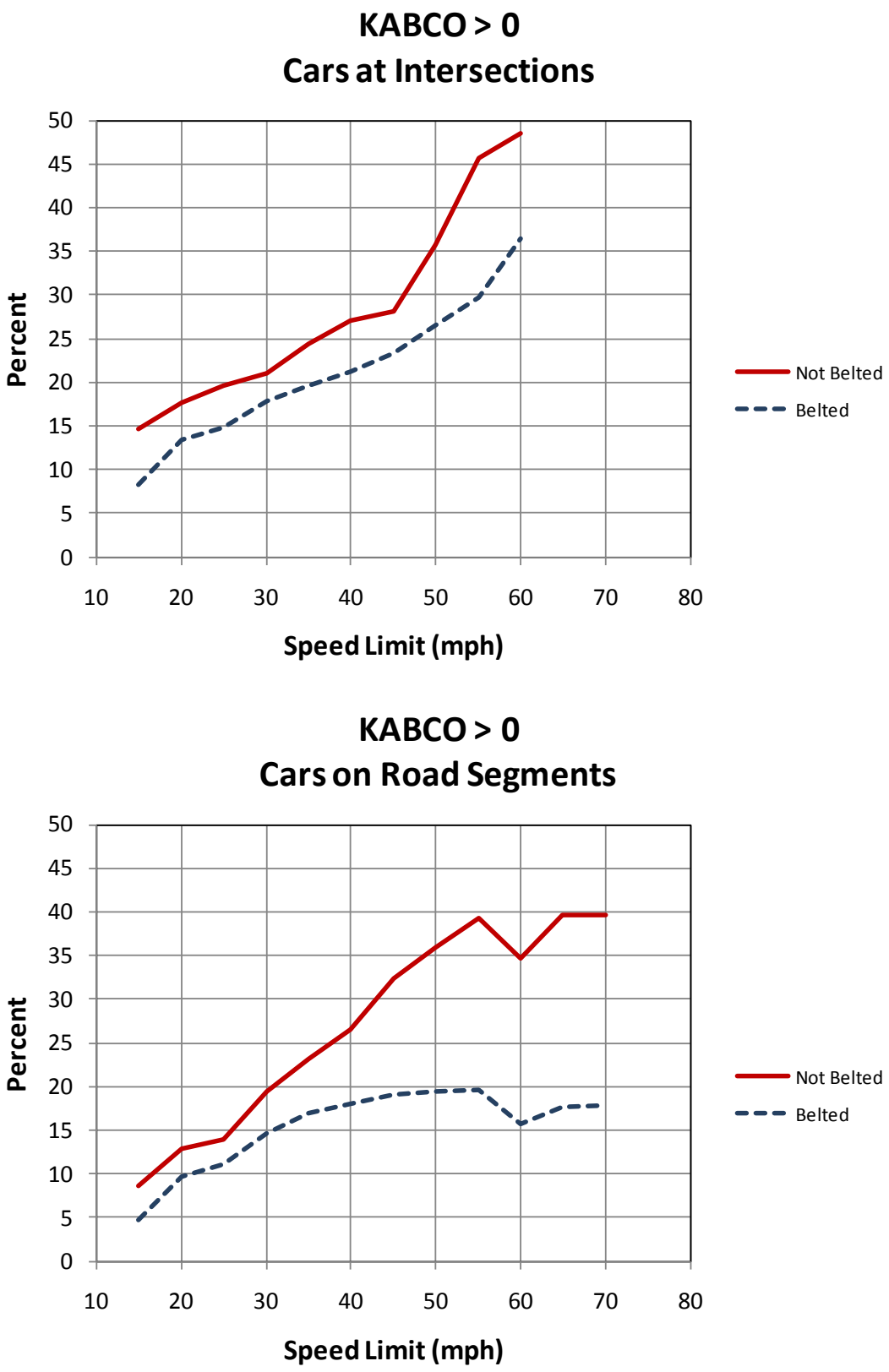
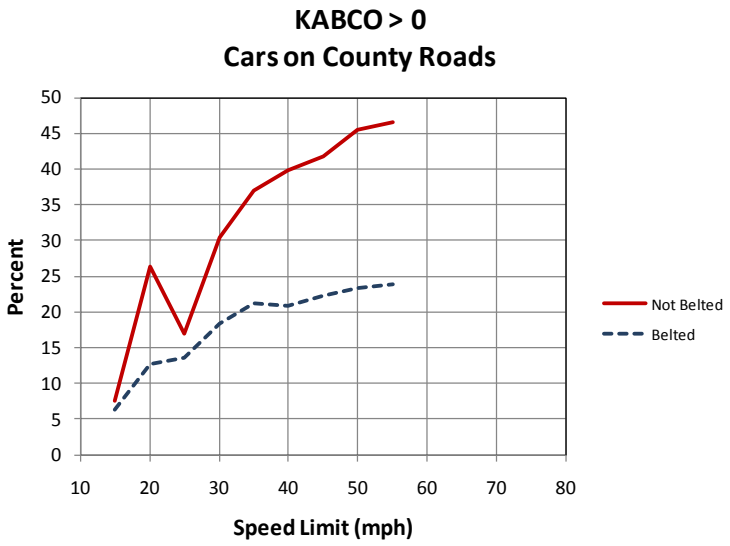
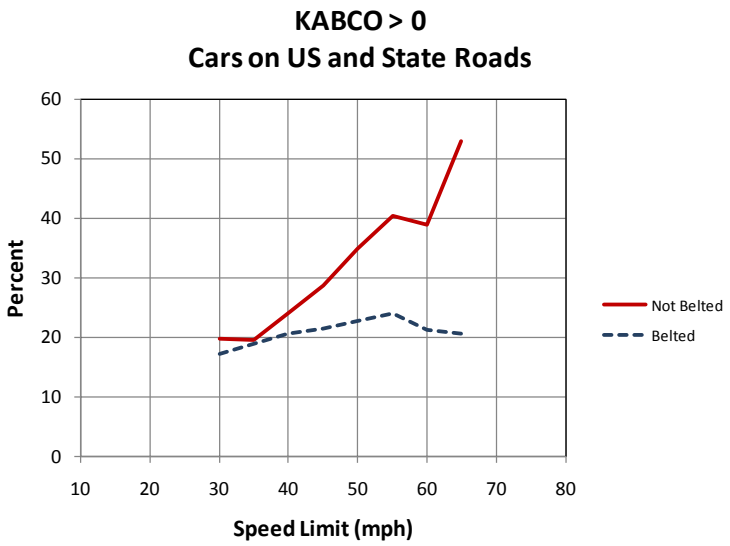


Figure 13 Speed and seatbelts impact on percent of injuries of car occupants in intersection and road segment crashes, 2003-2006 Police data





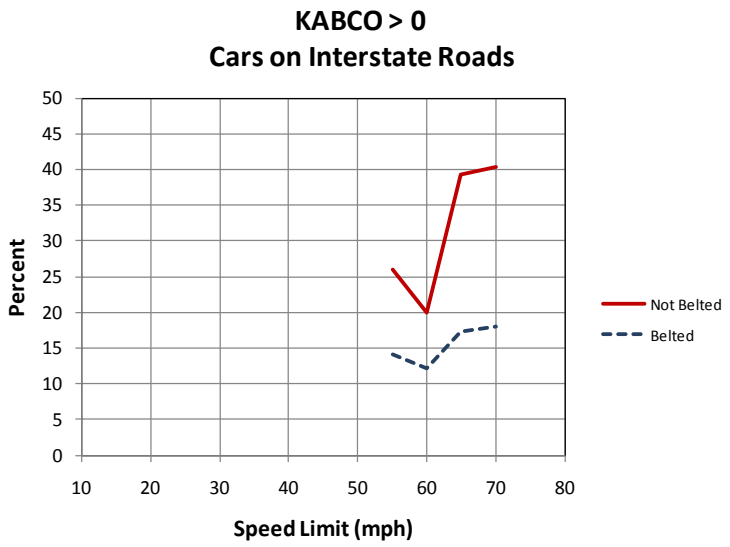
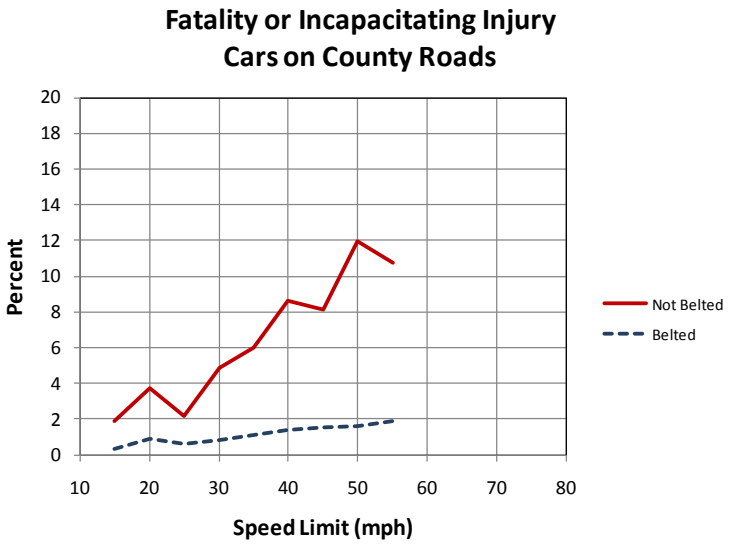
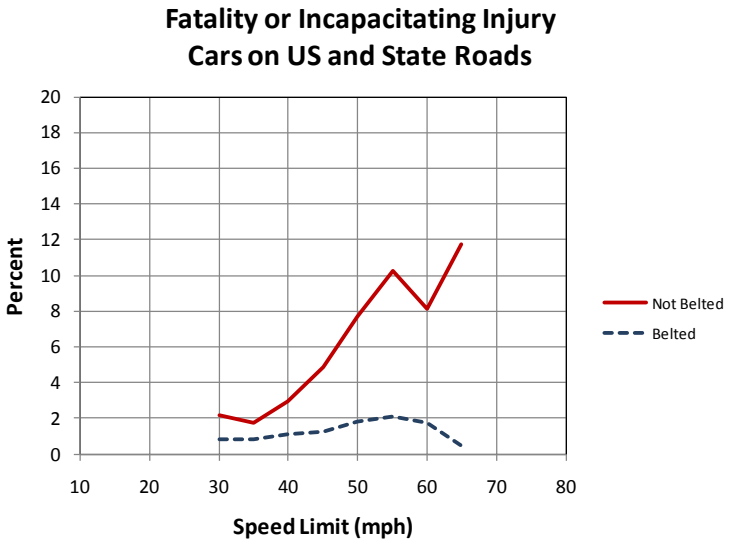


Figure 14 Speed and seatbelts impact on percent of injuries of car occupants on county, state, and interstate roads, 2003-2006 Police data





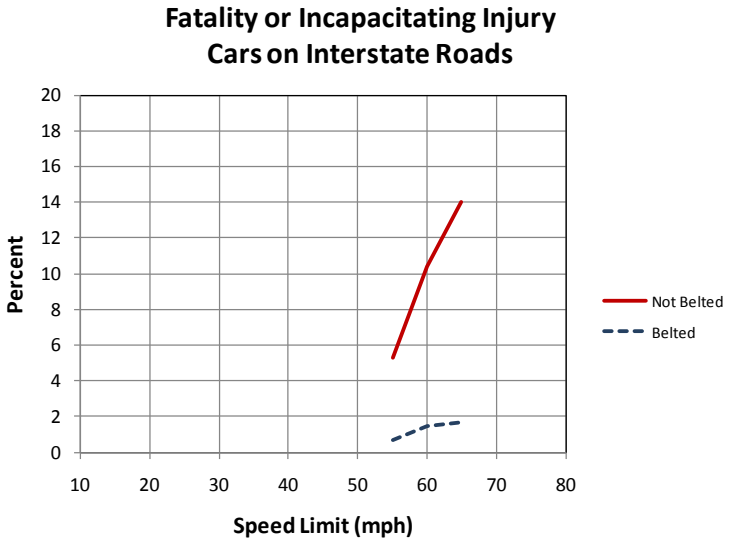


Figure 15 Speed and seatbelts impact on percent of severe injuries of car occupants on county, state, and interstate roads, 2003-2006 Police data

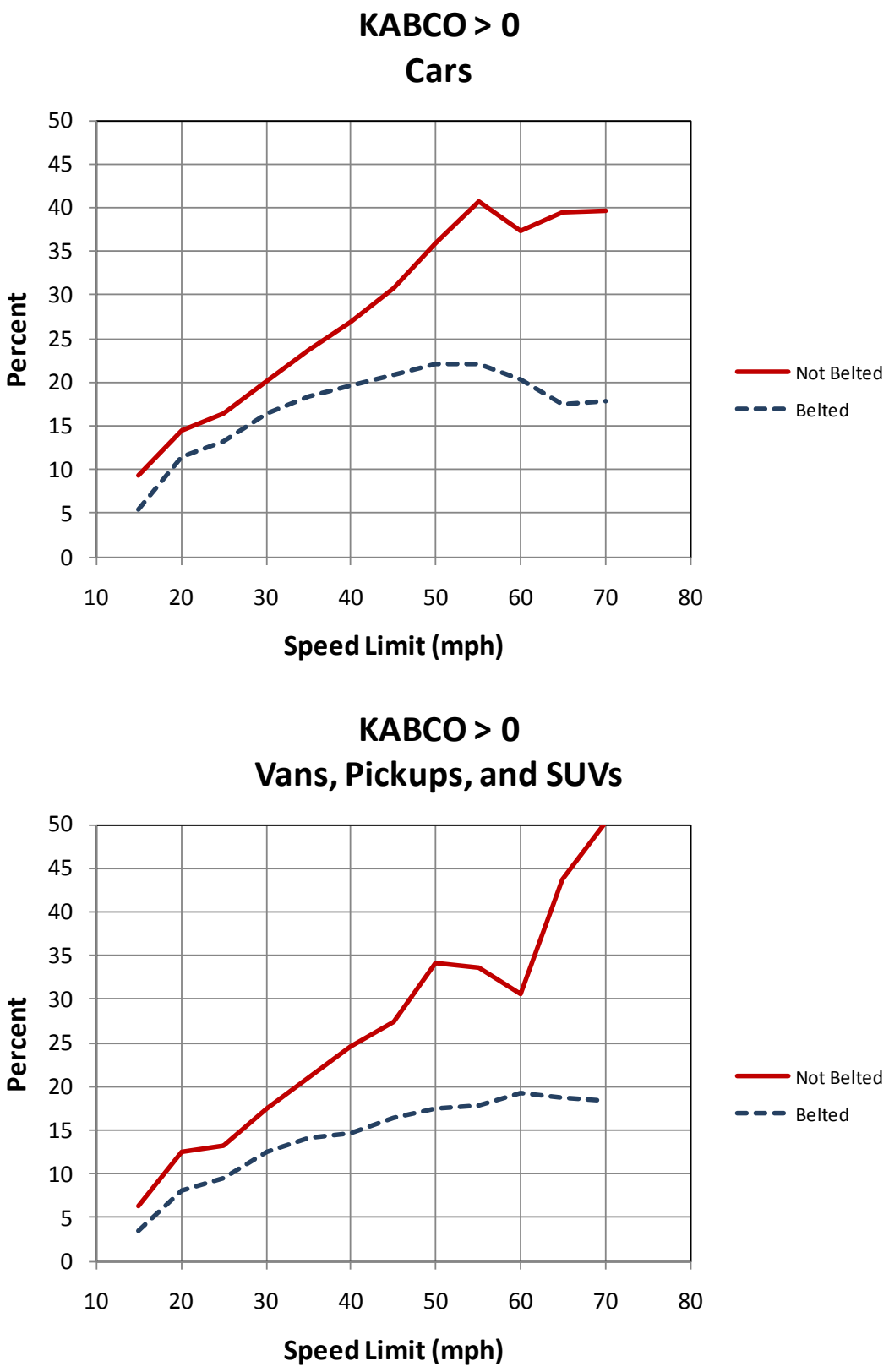


Figure 16 Speed and seatbelts impact on percent of injuries of car occupants vs. medium-size vehicle occupants, 2003-2006 Police data

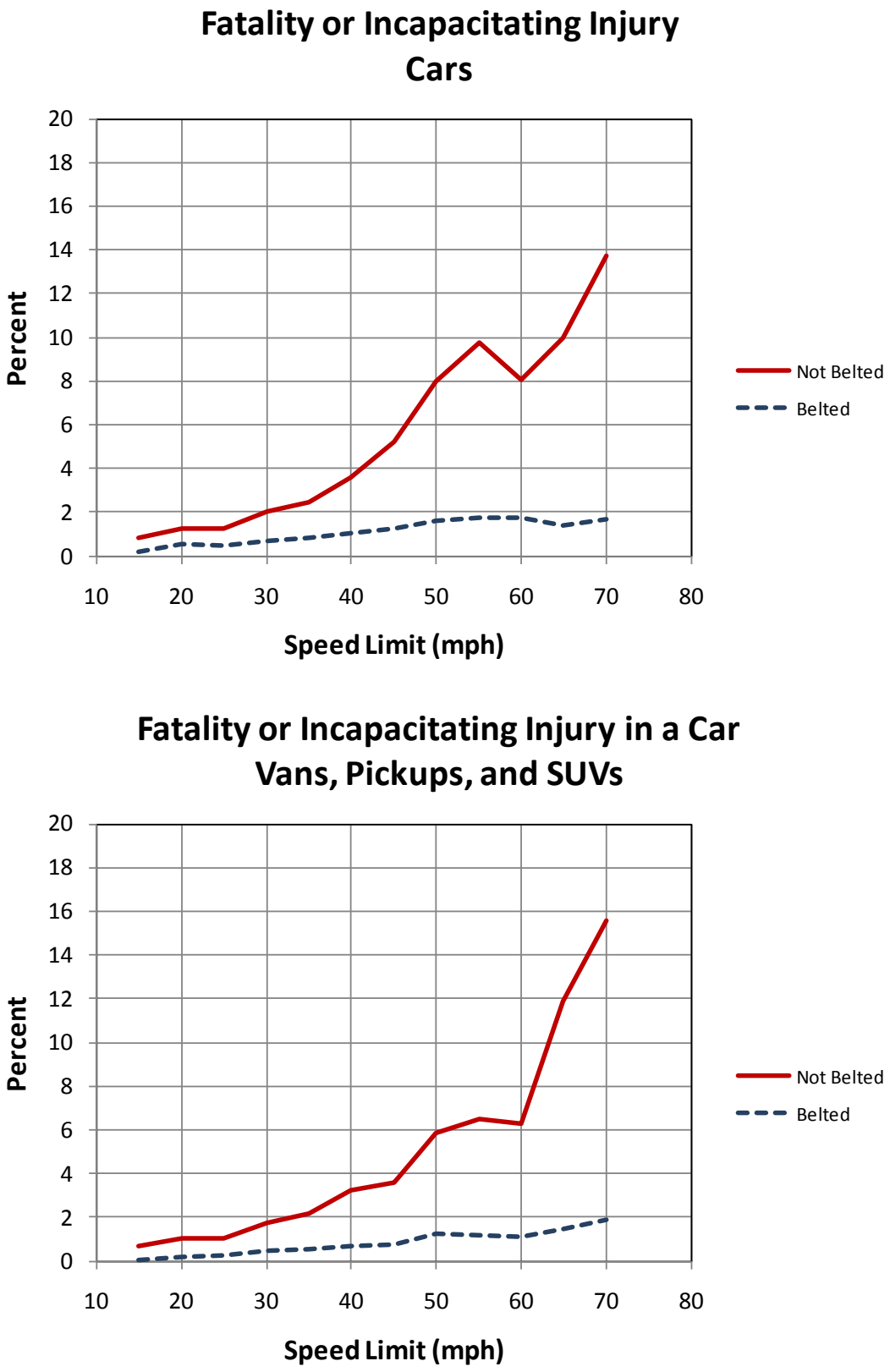


Figure 17 Speed and seatbelts impact on percent of severe injuries of car occupants vs. medium-size vehicle occupants, 2003-2006 Police data

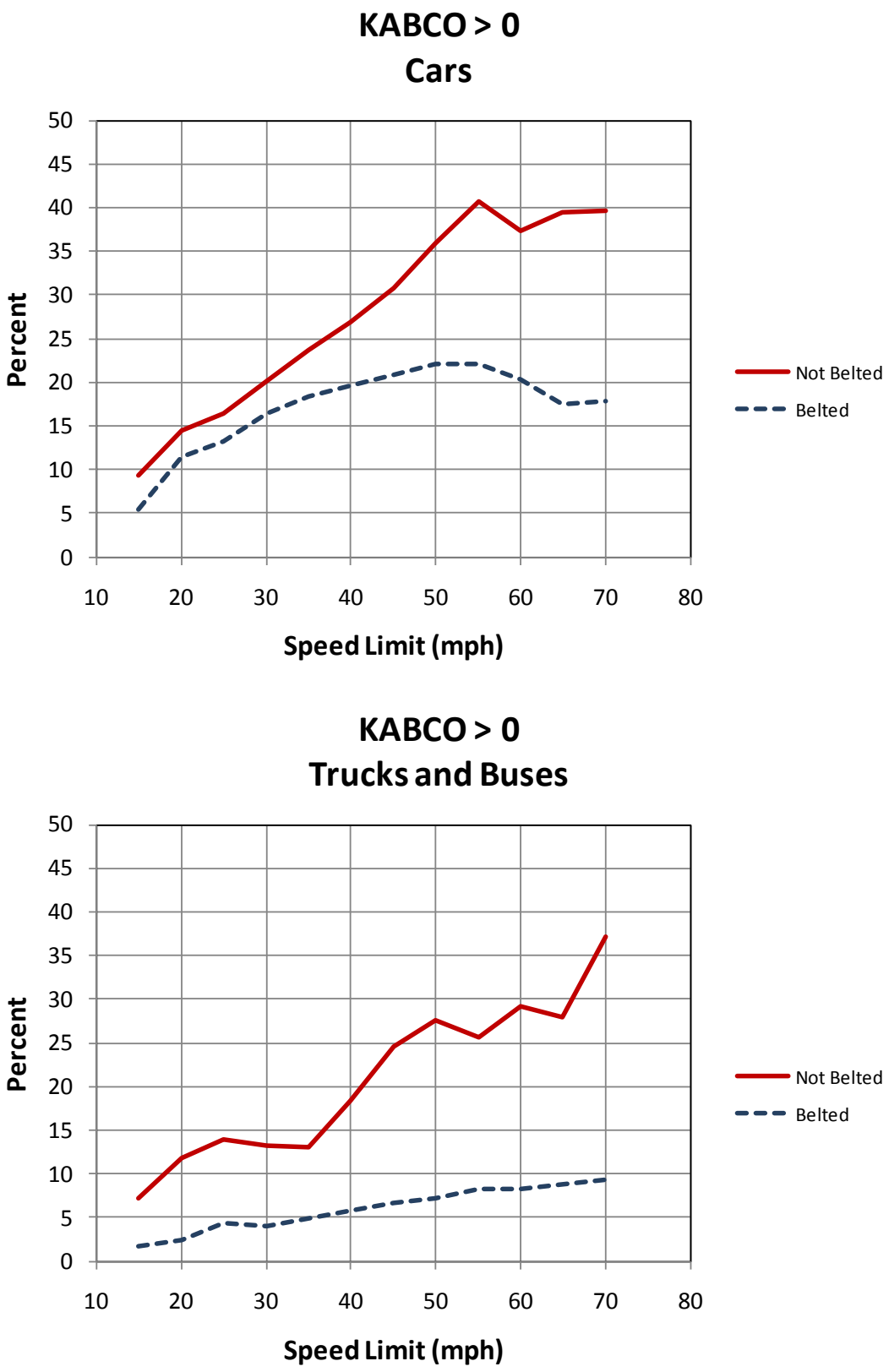


Figure 18 Speed and seatbelts impact on percent of injuries of car occupants vs. heavy vehicle occupants, 2003-2006 Police data

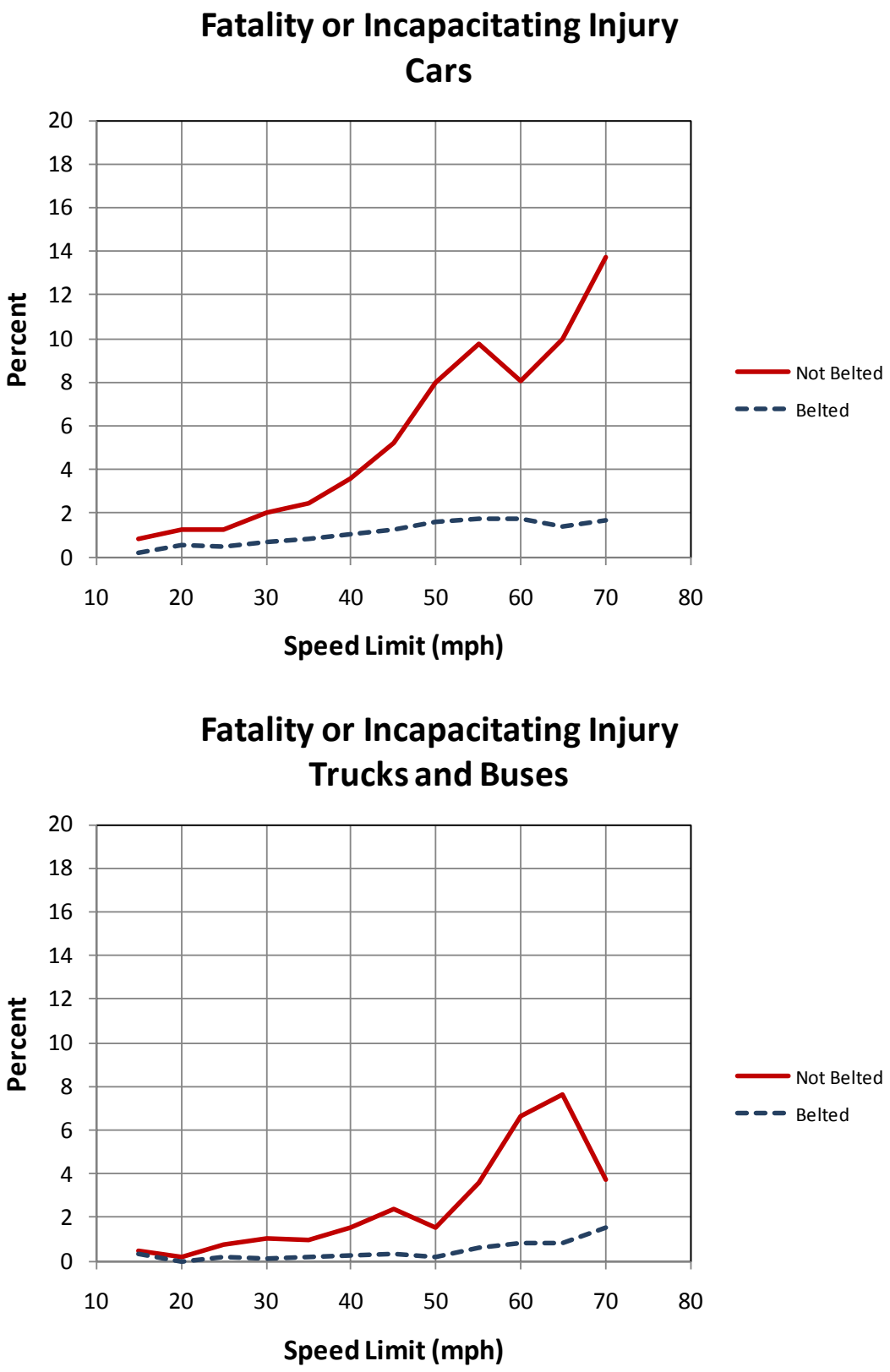


Figure 19 Speed and seatbelts impact on percent of severe injuries of car occupants vs. heavy vehicle occupants, 2003-2006 Police data

APPENDIX A
LOGISTIC REGRSSION MODELS – SAS REPORTS

MODEL: MAIS ≥ 3, Cars, Linked Data

The SAS System 08:01 Sunday, September 27, 2009 1

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_LINKED_MAIS
Response Variable	Injury_m
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	56492
Number of Observations Used	56492

Response Profile

Ordered Value	Injury_m	Total Frequency
1	1	3049
2	0	53443

Probability modeled is Injury_m='1'.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	23734.198	23690.314
SC	23743.139	23913.861
-2 Log L	23732.198	23640.314

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	91.8833	24	<.0001
Score	109.5412	24	<.0001
Wald	103.4358	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-3.0655	0.0763	1616.1116	<.0001
SL15*NSeatB	1	0.5298	0.3751	1.9946	0.1579
NSeatB*SL20	1	-0.0762	0.3935	0.0375	0.8464
NSeatB*SL25	1	0.4591	0.2439	3.5418	0.0598
NSeatB*SL30	1	0.1927	0.1272	2.2955	0.1298
NSeatB*SL35	1	0.2580	0.1471	3.0769	0.0794
NSeatB*SL40	1	0.5171	0.1583	10.6680	0.0011
NSeatB*SL45	1	0.5852	0.1609	13.2307	0.0003
NSeatB*SL50	1	0.5397	0.2708	3.9735	0.0462
NSeatB*SL55	1	0.7638	0.1254	37.0970	<.0001
NSeatB*SL60	1	1.5839	0.5013	9.9845	0.0016
NSeatB*SL65	1	-0.0700	0.5947	0.0139	0.9063
NSeatB*SL70	1	1.7533	0.4326	16.4270	<.0001
SL15*SeatB	1	-0.1223	0.2590	0.2232	0.6366
SL20*SeatB	1	0.1174	0.1740	0.4547	0.5001
SL25*SeatB	1	0.1335	0.1287	1.0754	0.2997
SL30*SeatB	1	0.0762	0.0880	0.7493	0.3867
SL35*SeatB	1	0.1309	0.0905	2.0928	0.1480
SL40*SeatB	1	0.1876	0.0951	3.8900	0.0486
SL45*SeatB	1	0.2430	0.0975	6.2100	0.0127
SL50*SeatB	1	0.3757	0.1232	9.2977	0.0023
SL55*SeatB	1	0.2396	0.0903	7.0350	0.0080
SL60*SeatB	1	0.9036	0.2748	10.8127	0.0010
SL65*SeatB	1	0.4240	0.1548	7.4992	0.0062
SL70*SeatB	1	0.2281	0.2854	0.6387	0.4242

Association of Predicted Probabilities and Observed Responses

Percent Concordant	47.4	Somers' D	0.081
Percent Discordant	39.3	Gamma	0.093
Percent Tied	13.3	Tau-a	0.008
Pairs	162947707	c	0.540

MODEL: MAIS ≥ 3, Cars, Linked Data (speed limit classes)

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_LINKED_MAIS
Response Variable	Injury_m
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read 56492
Number of Observations Used 56492

Response Profile

Ordered Value	Injury_m	Total Frequency
1	1	3049
2	0	53443

Probability modeled is Injury_m='1'.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	23734.198	23677.032
SC	23743.139	23739.625
-2 Log L	23732.198	23663.032

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	69.1654	6	<.0001
Score	76.8271	6	<.0001
Wald	75.1950	6	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-3.0655	0.0763	1616.1116	<.0001
LowSLNSeatB	1	0.2380	0.1049	5.1479	0.0233
MedSLNSeatB	1	0.5487	0.1200	20.9172	<.0001
HiSLNSeatB	1	0.7903	0.1207	42.8774	<.0001
LowSLSeatB	1	0.1001	0.0821	1.4889	0.2224
MedSLSeatB	1	0.2369	0.0853	7.7182	0.0055
HiSLSeatB	1	0.2725	0.0882	9.5506	0.0020

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
LowSLNSeatB	1.269	1.033	1.558
MedSLNSeatB	1.731	1.368	2.190
HiSLNSeatB	2.204	1.740	2.792
LowSLSeatB	1.105	0.941	1.298
MedSLSeatB	1.267	1.072	1.498
HiSLSeatB	1.313	1.105	1.561

Association of Predicted Probabilities and Observed Responses

Percent Concordant	39.5	Somers' D	0.071
Percent Discordant	32.4	Gamma	0.099
Percent Tied	28.2	Tau-a	0.007
Pairs	162947707	c	0.535

MODEL: Total Charges, Cars, Linked Data

The REG Procedure
Model: MODEL1
Dependent Variable: TOTCHRGS

Number of Observations Read	57364
Number of Observations Used	57364

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	24	20281225208	845051050	9.86	<.0001
Error	57339	4.912949E12	85682508		
Corrected Total	57363	4.933231E12			

Root MSE	9256.48467	R-Square	0.0041
Dependent Mean	2910.89837	Adj R-Sq	0.0037
Coeff Var	317.99409		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2832.33837	144.52676	19.60	<.0001
SL15NSeatB	1	-126.06404	882.68923	-0.14	0.8864
SL20NSeatB	1	1337.82348	718.44457	1.86	0.0626
SL25NSeatB	1	331.62396	560.64359	0.59	0.5542
SL30NSeatB	1	327.41536	255.01269	1.28	0.1992
SL35NSeatB	1	874.93163	303.79281	2.88	0.0040

SL40NSeatB	1	1816.09293	360.41477	5.04	<.0001
SL45NSeatB	1	1387.82642	376.25467	3.69	0.0002
SL50NSeatB	1	1304.35708	640.58874	2.04	0.0417
SL55NSeatB	1	1960.38505	298.96354	6.56	<.0001
SL60NSeatB	1	1306.30449	1755.27137	0.74	0.4567
SL65NSeatB	1	1421.75622	1085.70701	1.31	0.1904
SL70NSeatB	1	13237	1617.81570	8.18	<.0001
SL15SeatB	1	362.05333	467.23989	0.77	0.4384
SL20SeatB	1	-503.92944	345.01476	-1.46	0.1441
SL25SeatB	1	-230.68564	254.12843	-0.91	0.3640
SL30SeatB	1	-264.34505	168.30049	-1.57	0.1163
SL35SeatB	1	-254.01271	174.65208	-1.45	0.1458
SL40SeatB	1	-215.15511	186.07998	-1.16	0.2476
SL45SeatB	1	94.11459	193.49055	0.49	0.6267
SL50SeatB	1	66.48490	260.60431	0.26	0.7986
SL55SeatB	1	281.45992	177.05883	1.59	0.1119
SL60SeatB	1	1616.72452	748.17891	2.16	0.0307
SL65SeatB	1	933.01385	340.72096	2.74	0.0062

MODEL: Total Charges, Cars, Linked Data (speed limit classes)

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The REG Procedure
Model: MODEL1
Dependent Variable: TOTCHRGS

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
SL70SeatB	1	594.04444	596.30972	1.00	0.3192

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The REG Procedure
Model: MODEL1
Dependent Variable: TOTCHRGS

Number of Observations Read 57364
Number of Observations Used 57364

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	14508011315	2418001886	28.20	<.0001
Error	57357	4.918723E12	85756273		
Corrected Total	57363	4.933231E12			

Root MSE	9260.46831	R-Square	0.0029
Dependent Mean	2910.89837	Adj R-Sq	0.0028
Coeff Var	318.13094		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2832.33837	144.58896	19.59	<.0001
LowSLNSeatB	1	537.63474	209.67815	2.56	0.0103
MedSLNSeatB	1	1573.28925	266.23389	5.91	<.0001
HiSLNSeatB	1	2186.89756	287.71371	7.60	<.0001
LowSLSeatB	1	-255.02955	156.60260	-1.63	0.1034
MedSLSeatB	1	-55.42125	165.48409	-0.33	0.7377
HiSLSeatB	1	373.90887	172.99767	2.16	0.0307

MODEL: KABCO > 0, Cars, Linked Data

The SAS System 08:15 Sunday, September 27, 2009 1

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_LINKED_MAIS
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	56492
Number of Observations Used	56492

Response Profile

Ordered Value	Injury	Total Frequency
1	1	28466
2	0	28026

Probability modeled is Injury='1'.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	78313.114	75986.541
SC	78322.056	76210.087

-2 Log L	78311.114	75936.541

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	2374.5733	24	<.0001
Score	2283.9824	24	<.0001
Wald	2095.1599	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-1.0607	0.0360	868.3095	<.0001
SL15*NSeatB	1	0.4758	0.2030	5.4907	0.0191
NSeatB*SL20	1	1.0015	0.1581	40.1439	<.0001
NSeatB*SL25	1	0.6781	0.1247	29.5675	<.0001
NSeatB*SL30	1	1.1847	0.0583	412.4831	<.0001
NSeatB*SL35	1	1.2430	0.0687	327.1736	<.0001
NSeatB*SL40	1	1.5303	0.0823	346.0019	<.0001
NSeatB*SL45	1	1.7474	0.0879	395.5344	<.0001
NSeatB*SL50	1	1.9257	0.1533	157.8008	<.0001
NSeatB*SL55	1	2.2035	0.0759	841.9931	<.0001
NSeatB*SL60	1	4.3123	1.0166	17.9927	<.0001
NSeatB*SL65	1	1.6920	0.2501	45.7507	<.0001
NSeatB*SL70	1	2.5648	0.4528	32.0880	<.0001
SL15*SeatB	1	-0.0286	0.1169	0.0599	0.8066
SL20*SeatB	1	0.5170	0.0793	42.5450	<.0001
SL25*SeatB	1	0.5622	0.0591	90.5310	<.0001
SL30*SeatB	1	0.9768	0.0406	578.5393	<.0001
SL35*SeatB	1	1.0459	0.0419	624.5432	<.0001
SL40*SeatB	1	1.1709	0.0441	703.3886	<.0001
SL45*SeatB	1	1.3099	0.0457	820.9706	<.0001
SL50*SeatB	1	1.3175	0.0597	487.1166	<.0001
SL55*SeatB	1	1.3478	0.0424	1008.6252	<.0001
SL60*SeatB	1	2.4878	0.2065	145.1867	<.0001
SL65*SeatB	1	0.8548	0.0765	124.8271	<.0001
SL70*SeatB	1	2.7037	0.1744	240.4375	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	54.4	Somers' D	0.201
Percent Discordant	34.3	Gamma	0.227
Percent Tied	11.3	Tau-a	0.101
Pairs	797788116	c	0.601

MODEL: KABCO > 0, Cars

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	760486
Number of Observations Used	760486

Response Profile

Ordered Value	Injury	Total Frequency
1	1	137185
2	0	623301

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	717879.79	702302.75
SC	717891.34	702591.30
-2 Log L	717877.79	702252.75

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	15625.0406	24	<.0001
Score	15358.5135	24	<.0001
Wald	14169.4128	24	<.0001

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The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-2.3780	0.0128	34781.6232	<.0001
SL15*NSeatB	1	0.1103	0.0785	1.9740	0.1600
NSeatB*SL20	1	0.6058	0.0553	120.0056	<.0001
NSeatB*SL25	1	0.7516	0.0443	288.3201	<.0001
NSeatB*SL30	1	1.0049	0.0206	2389.7066	<.0001
NSeatB*SL35	1	1.2117	0.0238	2602.6605	<.0001
NSeatB*SL40	1	1.3732	0.0271	2574.3631	<.0001
NSeatB*SL45	1	1.5647	0.0283	3060.0018	<.0001
NSeatB*SL50	1	1.7967	0.0457	1542.9264	<.0001
NSeatB*SL55	1	1.9984	0.0233	7380.3718	<.0001
NSeatB*SL60	1	1.8611	0.1572	140.1021	<.0001
NSeatB*SL65	1	1.9502	0.0725	722.8882	<.0001
NSeatB*SL70	1	1.9556	0.1462	178.8228	<.0001
SL15*SeatB	1	-0.4790	0.0445	115.7268	<.0001
SL20*SeatB	1	0.3253	0.0289	126.9776	<.0001
SL25*SeatB	1	0.4962	0.0211	555.5285	<.0001
SL30*SeatB	1	0.7555	0.0145	2722.4652	<.0001
SL35*SeatB	1	0.8873	0.0148	3601.5400	<.0001
SL40*SeatB	1	0.9642	0.0155	3853.9844	<.0001
SL45*SeatB	1	1.0441	0.0161	4205.3277	<.0001
SL50*SeatB	1	1.1153	0.0207	2895.3327	<.0001
SL55*SeatB	1	1.1173	0.0150	5533.3948	<.0001
SL60*SeatB	1	1.0123	0.0617	268.8556	<.0001
SL65*SeatB	1	0.8288	0.0275	911.0060	<.0001
SL70*SeatB	1	0.8535	0.0463	339.4903	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	53.3	Somers' D	0.187
Percent Discordant	34.6	Gamma	0.213
Percent Tied	12.1	Tau-a	0.055
Pairs	85507547685	c	0.594

MODEL: KABCO > 0, Cars in Urban Areas

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS_URBAN
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read 556489
Number of Observations Used 556489

Response Profile

Ordered Value	Injury	Total Frequency
1	1	90412
2	0	466077

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	493875.79	486171.79
SC	493887.02	486452.53
-2 Log L	493873.79	486121.79

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	7751.9951	24	<.0001
Score	6975.2953	24	<.0001
Wald	6548.9063	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-2.4470	0.0143	29344.2759	<.0001
SL15*NSeatB	1	0.1716	0.0842	4.1507	0.0416
NSeatB*SL20	1	0.6136	0.0604	103.2556	<.0001
NSeatB*SL25	1	0.8074	0.0468	297.5345	<.0001
NSeatB*SL30	1	1.0257	0.0223	2118.4243	<.0001
NSeatB*SL35	1	1.1946	0.0262	2073.8210	<.0001
NSeatB*SL40	1	1.2417	0.0321	1497.9928	<.0001
NSeatB*SL45	1	1.2543	0.0393	1016.4648	<.0001
NSeatB*SL50	1	1.5277	0.0736	430.3229	<.0001
NSeatB*SL55	1	1.4965	0.0509	864.4894	<.0001
NSeatB*SL60	1	1.0607	0.5002	4.4964	0.0340

NSeatB*SL65	1	1.4173	0.1577	80.7444	<.0001
NSeatB*SL70	1	1.0607	0.5592	3.5977	0.0579
SL15*SeatB	1	-0.4631	0.0487	90.3467	<.0001
SL20*SeatB	1	0.3893	0.0310	157.5215	<.0001
SL25*SeatB	1	0.5657	0.0225	630.7371	<.0001
SL30*SeatB	1	0.8152	0.0160	2597.8962	<.0001
SL35*SeatB	1	0.9356	0.0164	3267.3460	<.0001
SL40*SeatB	1	0.9952	0.0176	3186.0424	<.0001
SL45*SeatB	1	1.0421	0.0193	2920.4121	<.0001
SL50*SeatB	1	1.0752	0.0280	1470.1222	<.0001
SL55*SeatB	1	0.8771	0.0226	1506.4140	<.0001
SL60*SeatB	1	1.0924	0.1988	30.1980	<.0001
SL65*SeatB	1	0.8089	0.0514	247.2417	<.0001
SL70*SeatB	1	1.0814	0.1442	56.2697	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	50.6	Somers' D	0.156
Percent Discordant	35.0	Gamma	0.183
Percent Tied	14.5	Tau-a	0.043
Pairs	42138953724	c	0.578

MODEL: KABCO > 0, Cars in Rural Areas

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS_RURAL
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	203997
Number of Observations Used	203997

Response Profile

Ordered Value	Injury	Total Frequency
1	1	46773
2	0	157224

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	219669.34	214447.86
SC	219679.57	214703.51
-2 Log L	219667.34	214397.86

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	5269.4835	24	<.0001
Score	5477.6150	24	<.0001
Wald	5110.3213	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-2.0601	0.0284	5255.3624	<.0001
SL15*NSeatB	1	-0.1552	0.2168	0.5124	0.4741
NSeatB*SL20	1	0.6701	0.1395	23.0863	<.0001
NSeatB*SL25	1	0.5646	0.1401	16.2320	<.0001
NSeatB*SL30	1	1.1362	0.0568	400.3909	<.0001
NSeatB*SL35	1	1.3902	0.0573	588.1699	<.0001
NSeatB*SL40	1	1.6095	0.0529	925.3612	<.0001
NSeatB*SL45	1	1.6713	0.0459	1327.4254	<.0001
NSeatB*SL50	1	1.7014	0.0629	732.2888	<.0001
NSeatB*SL55	1	1.8034	0.0356	2568.7628	<.0001
NSeatB*SL60	1	1.6658	0.1694	96.6552	<.0001
NSeatB*SL65	1	1.8171	0.0863	443.7687	<.0001
NSeatB*SL70	1	1.7295	0.1550	124.4713	<.0001
SL15*SeatB	1	-0.4683	0.1102	18.0420	<.0001
SL20*SeatB	1	0.0466	0.0815	0.3270	0.5674
SL25*SeatB	1	0.1710	0.0674	6.4332	0.0112
SL30*SeatB	1	0.5324	0.0364	214.0384	<.0001
SL35*SeatB	1	0.7258	0.0356	416.0785	<.0001
SL40*SeatB	1	0.7577	0.0333	518.6285	<.0001
SL45*SeatB	1	0.8279	0.0322	661.4978	<.0001
SL50*SeatB	1	0.8957	0.0361	615.9402	<.0001
SL55*SeatB	1	0.8904	0.0298	893.3922	<.0001
SL60*SeatB	1	0.6932	0.0695	99.5070	<.0001
SL65*SeatB	1	0.5404	0.0399	183.8838	<.0001
SL70*SeatB	1	0.5195	0.0548	89.8764	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	48.9	Somers' D	0.181
Percent Discordant	30.8	Gamma	0.226
Percent Tied	20.3	Tau-a	0.064
Pairs	7353838152	c	0.590

MODEL: KABCO > 0, Cars at Intersections

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS_JUNCTION
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	329076
Number of Observations Used	329076

Response Profile

Ordered Value	Injury	Total Frequency
1	1	66779
2	0	262297

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	331997.50	327825.89
SC	332008.20	328050.68
-2 Log L	331995.50	327783.89

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq

Likelihood Ratio	4211.6049	20 <.0001
Score	4440.3967	20 <.0001
Wald	4241.7626	20 <.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-1.7476	0.0209	7014.9975	<.0001
SL15*NSeatB	1	-0.0231	0.1723	0.0180	0.8933
NSeatB*SL20	1	0.2072	0.0861	5.7882	0.0161
NSeatB*SL25	1	0.3344	0.0626	28.5336	<.0001
NSeatB*SL30	1	0.4241	0.0305	193.5635	<.0001
NSeatB*SL35	1	0.6110	0.0347	309.2919	<.0001
NSeatB*SL40	1	0.7561	0.0408	343.5681	<.0001
NSeatB*SL45	1	0.8085	0.0469	297.3535	<.0001
NSeatB*SL50	1	1.1578	0.0780	220.1922	<.0001
NSeatB*SL55	1	1.5666	0.0454	1191.2729	<.0001
NSeatB*SL60	1	1.6870	0.3489	23.3733	<.0001
SL15*SeatB	1	-0.6547	0.0828	62.5907	<.0001
SL20*SeatB	1	-0.1231	0.0416	8.7379	0.0031
SL25*SeatB	1	-0.00075	0.0299	0.0006	0.9799
SL30*SeatB	1	0.2161	0.0226	91.3875	<.0001
SL35*SeatB	1	0.3379	0.0231	214.2758	<.0001
SL40*SeatB	1	0.4351	0.0242	323.2194	<.0001
SL45*SeatB	1	0.5536	0.0255	471.6281	<.0001
SL50*SeatB	1	0.7293	0.0328	495.0067	<.0001
SL55*SeatB	1	0.8822	0.0255	1198.5202	<.0001
SL60*SeatB	1	1.1901	0.1088	119.7051	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	49.8	Somers' D	0.145
Percent Discordant	35.3	Gamma	0.171
Percent Tied	14.8	Tau-a	0.047
Pairs	17515931363	c	0.573

MODEL: KABCO > 0, Cars on Road Segments

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_SEGMENT
Response Variable	Injury
Number of Response Levels	2
Model	binary logit

Optimization Technique Fisher's scoring

Number of Observations Read 431410
Number of Observations Used 431410

Response Profile

Ordered Value	Injury	Total Frequency
1	1	70406
2	0	361004

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	383903.31	371283.61
SC	383914.29	371557.98
-2 Log L	383901.31	371233.61

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	12667.7011	24	<.0001
Score	12468.0142	24	<.0001
Wald	11167.0748	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-2.6499	0.0163	26470.3285	<.0001
SL15*NSeatB	1	0.2789	0.0886	9.8970	0.0017
NSeatB*SL20	1	0.7323	0.0725	102.1156	<.0001
NSeatB*SL25	1	0.8232	0.0634	168.4569	<.0001
NSeatB*SL30	1	1.2232	0.0285	1835.9514	<.0001
NSeatB*SL35	1	1.4519	0.0332	1911.2593	<.0001
NSeatB*SL40	1	1.6337	0.0364	2009.0328	<.0001
NSeatB*SL45	1	1.9110	0.0356	2882.2650	<.0001
NSeatB*SL50	1	2.0730	0.0565	1344.9532	<.0001

NSeatB*SL55	1	2.2109	0.0276	6425.9455	<.0001
NSeatB*SL60	1	2.0199	0.1776	129.3512	<.0001
NSeatB*SL65	1	2.2322	0.0734	925.4010	<.0001
NSeatB*SL70	1	2.2275	0.1466	230.8928	<.0001
SL15*SeatB	1	-0.3478	0.0531	42.8911	<.0001
SL20*SeatB	1	0.4261	0.0408	109.2078	<.0001
SL25*SeatB	1	0.5783	0.0316	335.1434	<.0001
SL30*SeatB	1	0.8879	0.0198	2019.0230	<.0001
SL35*SeatB	1	1.0557	0.0199	2804.0824	<.0001
SL40*SeatB	1	1.1314	0.0208	2971.0690	<.0001
SL45*SeatB	1	1.2086	0.0210	3304.1640	<.0001
SL50*SeatB	1	1.2279	0.0270	2066.8641	<.0001
SL55*SeatB	1	1.2426	0.0189	4337.2779	<.0001
SL60*SeatB	1	0.9684	0.0776	155.6927	<.0001
SL65*SeatB	1	1.1073	0.0293	1425.7714	<.0001
SL70*SeatB	1	1.1262	0.0475	561.5561	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	56.6	Somers' D	0.232
Percent Discordant	33.4	Gamma	0.258
Percent Tied	10.0	Tau-a	0.063
Pairs	25416847624	c	0.616

MODEL: KABCO > 0, Cars on County Roads

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS_COUNTY
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	88460
Number of Observations Used	88460

Response Profile

Ordered Value	Injury	Total Frequency
1	1	20952
2	0	67508

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	96852.431	94648.630
SC	96861.821	94827.046
-2 Log L	96850.431	94610.630

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	2239.8008	18	<.0001
Score	2434.1504	18	<.0001
Wald	2272.2936	18	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-1.5902	0.0437	1325.4735	<.0001
SL15*NSeatB	1	-0.9153	0.5218	3.0764	0.0794
NSeatB*SL20	1	0.5606	0.2017	7.7253	0.0054
NSeatB*SL25	1	-0.00166	0.2329	0.0001	0.9943
NSeatB*SL30	1	0.7642	0.0759	101.3518	<.0001
NSeatB*SL35	1	1.0592	0.0727	212.5171	<.0001
NSeatB*SL40	1	1.1804	0.0683	298.2373	<.0001
NSeatB*SL45	1	1.2551	0.0626	402.2314	<.0001
NSeatB*SL50	1	1.4100	0.0973	210.1615	<.0001
NSeatB*SL55	1	1.4550	0.0552	694.7067	<.0001
SL15*SeatB	1	-1.1018	0.2297	23.0126	<.0001
SL20*SeatB	1	-0.3441	0.1161	8.7891	0.0030
SL25*SeatB	1	-0.2665	0.0983	7.3454	0.0067
SL30*SeatB	1	0.0961	0.0514	3.4867	0.0619
SL35*SeatB	1	0.2783	0.0513	29.3840	<.0001
SL40*SeatB	1	0.2551	0.0487	27.4240	<.0001
SL45*SeatB	1	0.3418	0.0478	51.0747	<.0001
SL50*SeatB	1	0.3961	0.0562	49.6604	<.0001
SL55*SeatB	1	0.4255	0.0465	83.9077	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	51.8	Somers' D	0.171
Percent Discordant	34.7	Gamma	0.198
Percent Tied	13.5	Tau-a	0.062
Pairs	1414427616	c	0.586

MODEL: KABCO > 0, Cars on Interstate Roads

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS_INTERSTATE
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	39776
Number of Observations Used	39776

Response Profile

Ordered Value	Injury	Total Frequency
1	1	6328
2	0	33448

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	34858.450	34358.448
SC	34867.041	34418.585
-2 Log L	34856.450	34344.448

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	512.0021	6	<.0001
Score	607.7879	6	<.0001
Wald	555.4379	6	<.0001

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The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-1.9527	0.0345	3202.4676	<.0001
SL55*NSeatB	1	0.9072	0.0752	145.6436	<.0001
NSeatB*SL65	1	1.5146	0.0827	335.1651	<.0001
NSeatB*SL70	1	1.5645	0.1507	107.7960	<.0001
SL55*SeatB	1	0.1501	0.0413	13.1756	0.0003
SL65*SeatB	1	0.3832	0.0429	79.6462	<.0001
SL70*SeatB	1	0.4327	0.0567	58.1743	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	43.6	Somers' D	0.135
Percent Discordant	30.1	Gamma	0.183
Percent Tied	26.3	Tau-a	0.036
Pairs	211658944	c	0.568

MODEL: KABCO > 0, Cars on US and State Roads

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS_STATE
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	176722
Number of Observations Used	176722

Response Profile

Ordered Value	Injury	Total Frequency
1	1	38594
2	0	138128

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	185510.75	183429.03
SC	185520.83	183600.43
-2 Log L	185508.75	183395.03

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	2113.7233	16	<.0001
Score	2254.7541	16	<.0001
Wald	2157.8831	16	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-1.7408	0.0264	4352.1391	<.0001
SL30*NSeatB	1	0.3373	0.0557	36.6861	<.0001
NSeatB*SL35	1	0.3288	0.0565	33.9062	<.0001
NSeatB*SL40	1	0.5855	0.0607	93.0357	<.0001
NSeatB*SL45	1	0.8232	0.0473	302.8585	<.0001
NSeatB*SL50	1	1.1115	0.0634	307.1941	<.0001
NSeatB*SL55	1	1.3491	0.0376	1290.7312	<.0001
NSeatB*SL60	1	1.2830	0.1644	60.8986	<.0001
NSeatB*SL65	1	1.8586	0.4866	14.5872	0.0001
SL30*SeatB	1	0.1596	0.0331	23.2069	<.0001
SL35*SeatB	1	0.2873	0.0314	83.5848	<.0001
SL40*SeatB	1	0.3917	0.0331	140.3099	<.0001
SL45*SeatB	1	0.4387	0.0302	211.3252	<.0001
SL50*SeatB	1	0.5143	0.0337	233.0375	<.0001
SL55*SeatB	1	0.5868	0.0284	427.3026	<.0001
SL60*SeatB	1	0.4325	0.0683	40.0874	<.0001
SL65*SeatB	1	0.3933	0.1676	5.5080	0.0189

Association of Predicted Probabilities and Observed Responses

Percent Concordant	48.5	Somers' D	0.130
Percent Discordant	35.5	Gamma	0.155
Percent Tied	16.0	Tau-a	0.044
Pairs	5330912032	c	0.565

MODEL: KABCO > 0, Trucks and Buses

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The LOGISTIC Procedure

Model Information

Data Set	W.HEAVY
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	69317
Number of Observations Used	69317

Response Profile

Ordered Value	Injury	Total Frequency
1	1	5278
2	0	64039

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	37328.719	34758.177
SC	37337.866	34986.839
-2 Log L	37326.719	34708.177

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	2618.5420	24	<.0001
Score	3241.1687	24	<.0001
Wald	2619.5791	24	<.0001

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The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-3.6600	0.0635	3317.1717	<.0001
SL15*NSeatB	1	1.1106	0.1999	30.8530	<.0001
NSeatB*SL20	1	1.6550	0.1583	109.3452	<.0001
NSeatB*SL25	1	1.8379	0.1291	202.6946	<.0001
NSeatB*SL30	1	1.7719	0.0861	423.4247	<.0001
NSeatB*SL35	1	1.7681	0.1018	301.7274	<.0001
NSeatB*SL40	1	2.1736	0.1084	402.0730	<.0001
NSeatB*SL45	1	2.5367	0.0950	713.3568	<.0001
NSeatB*SL50	1	2.6923	0.1228	480.7289	<.0001
NSeatB*SL55	1	2.5972	0.0805	1040.2151	<.0001
NSeatB*SL60	1	2.7706	0.1450	364.8895	<.0001
NSeatB*SL65	1	2.7086	0.1365	393.7978	<.0001
NSeatB*SL70	1	3.1325	0.4034	60.2993	<.0001
SL15*SeatB	1	-0.4195	0.2600	2.6033	0.1066
SL20*SeatB	1	-0.00525	0.1955	0.0007	0.9786
SL25*SeatB	1	0.5755	0.1183	23.6600	<.0001
SL30*SeatB	1	0.4659	0.0853	29.8071	<.0001
SL35*SeatB	1	0.6871	0.0877	61.4096	<.0001
SL40*SeatB	1	0.8707	0.0943	85.3303	<.0001
SL45*SeatB	1	1.0100	0.0840	144.5960	<.0001
SL50*SeatB	1	1.1142	0.1051	112.4461	<.0001
SL55*SeatB	1	1.2494	0.0716	304.3971	<.0001
SL60*SeatB	1	1.2499	0.0909	189.0706	<.0001
SL65*SeatB	1	1.3176	0.0903	212.7916	<.0001
SL70*SeatB	1	1.3941	0.2195	40.3320	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	64.5	Somers' D	0.384
Percent Discordant	26.1	Gamma	0.424
Percent Tied	9.5	Tau-a	0.054
Pairs	337997842	c	0.692

MODEL: KABCO > 0, Vans, Pickups, and SUVs

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The LOGISTIC Procedure

Model Information

Data Set	W.MEDIUM
Response Variable	Injury
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read 498583
Number of Observations Used 498583

Response Profile

Ordered Value	Injury	Total Frequency
1	1	75131
2	0	423452

Probability modeled is Injury=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	422703.12	409053.86
SC	422714.24	409331.85
-2 Log L	422701.12	409003.86

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	13697.2624	24	<.0001
Score	14188.0421	24	<.0001
Wald	12771.5971	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-2.7012	0.0176	23631.1492	<.0001
SL15*NSeatB	1	0.0166	0.0980	0.0289	0.8651
NSeatB*SL20	1	0.7571	0.0620	148.9667	<.0001
NSeatB*SL25	1	0.8159	0.0503	262.8610	<.0001
NSeatB*SL30	1	1.1440	0.0251	2074.3074	<.0001
NSeatB*SL35	1	1.3775	0.0287	2305.9090	<.0001
NSeatB*SL40	1	1.5756	0.0310	2575.8561	<.0001
NSeatB*SL45	1	1.7250	0.0300	3301.9289	<.0001
NSeatB*SL50	1	2.0475	0.0417	2405.4931	<.0001
NSeatB*SL55	1	2.0181	0.0241	7014.6820	<.0001
NSeatB*SL60	1	1.8815	0.1522	152.7583	<.0001

NSeatB*SL65	1	2.4517	0.0664	1363.5586	<.0001
NSeatB*SL70	1	2.7148	0.1176	533.1637	<.0001
SL15*SeatB	1	-0.6241	0.0714	76.3012	<.0001
SL20*SeatB	1	0.2699	0.0438	37.9733	<.0001
SL25*SeatB	1	0.4443	0.0313	201.8304	<.0001
SL30*SeatB	1	0.7636	0.0204	1400.1918	<.0001
SL35*SeatB	1	0.9002	0.0209	1861.1337	<.0001
SL40*SeatB	1	0.9421	0.0217	1876.8632	<.0001
SL45*SeatB	1	1.0696	0.0220	2354.4465	<.0001
SL50*SeatB	1	1.1458	0.0277	1710.2050	<.0001
SL55*SeatB	1	1.1768	0.0203	3358.7336	<.0001
SL60*SeatB	1	1.2649	0.0764	274.2102	<.0001
SL65*SeatB	1	1.2275	0.0329	1394.8166	<.0001
SL70*SeatB	1	1.2138	0.0566	459.4356	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	57.2	Somers' D	0.239
Percent Discordant	33.2	Gamma	0.265
Percent Tied	9.6	Tau-a	0.061
Pairs	31814372212	c	0.620

MODEL: Fatalities and Incapacitating Injuries, Cars

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	760486
Number of Observations Used	760486

Response Profile

Ordered Value	Inj Severe	Total Frequency
1	1	9552
2	0	750934

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	102607.68	96533.072
SC	102619.22	96821.615
-2 Log L	102605.68	96483.072

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	6122.6107	24	<.0001
Score	11151.5573	24	<.0001
Wald	7583.2152	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-5.2757	0.0499	11159.4405	<.0001
SL15*NSeatB	1	0.4752	0.2559	3.4475	0.0633
NSeatB*SL20	1	0.9131	0.1773	26.5277	<.0001
NSeatB*SL25	1	0.8929	0.1508	35.0526	<.0001
NSeatB*SL30	1	1.4091	0.0677	433.3311	<.0001
NSeatB*SL35	1	1.5918	0.0744	457.6767	<.0001
NSeatB*SL40	1	1.9849	0.0757	688.1474	<.0001
NSeatB*SL45	1	2.3746	0.0724	1075.8383	<.0001
NSeatB*SL50	1	2.8319	0.0924	939.9208	<.0001
NSeatB*SL55	1	3.0516	0.0594	2637.4342	<.0001
NSeatB*SL60	1	2.8395	0.2831	100.5702	<.0001
NSeatB*SL65	1	3.0771	0.1267	590.2116	<.0001
NSeatB*SL70	1	3.4357	0.2131	259.9227	<.0001
SL15*SeatB	1	-0.8216	0.2104	15.2538	<.0001
SL20*SeatB	1	0.0492	0.1234	0.1592	0.6899
SL25*SeatB	1	-0.0597	0.0961	0.3852	0.5348
SL30*SeatB	1	0.3003	0.0587	26.1807	<.0001
SL35*SeatB	1	0.4695	0.0595	62.2858	<.0001
SL40*SeatB	1	0.7272	0.0607	143.3673	<.0001
SL45*SeatB	1	0.9002	0.0616	213.5924	<.0001
SL50*SeatB	1	1.1809	0.0731	261.0516	<.0001
SL55*SeatB	1	1.2631	0.0558	512.1044	<.0001
SL60*SeatB	1	1.2266	0.1939	40.0360	<.0001
SL65*SeatB	1	1.0098	0.0936	116.4806	<.0001
SL70*SeatB	1	1.2117	0.1415	73.2889	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	63.7	Somers' D	0.382
Percent Discordant	25.4	Gamma	0.429
Percent Tied	10.9	Tau-a	0.009
Pairs	7172921568	c	0.691

MODEL: Fatalities and Incapacitating Injuries, Cars in Urban Areas

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_URBAN_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	556489
Number of Observations Used	556489

Response Profile

Ordered Value	Inj Severe	Total Frequency
1	1	4713
2	0	551776

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	54362.460	53010.473
SC	54373.689	53291.208
-2 Log L	54360.460	52960.473

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq

Likelihood Ratio	1399.9865	24 <.0001
Score	2026.0955	24 <.0001
Wald	1655.2779	24 <.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-5.4748	0.0600	8327.5402	<.0001
SL15*NSeatB	1	0.5990	0.2848	4.4232	0.0355
NSeatB*SL20	1	0.9799	0.2026	23.3908	<.0001
NSeatB*SL25	1	1.0554	0.1631	41.8716	<.0001
NSeatB*SL30	1	1.4967	0.0784	364.8694	<.0001
NSeatB*SL35	1	1.6331	0.0876	347.7820	<.0001
NSeatB*SL40	1	1.6850	0.1018	273.7570	<.0001
NSeatB*SL45	1	2.0932	0.1056	393.0805	<.0001
NSeatB*SL50	1	2.4610	0.1657	220.7052	<.0001
NSeatB*SL55	1	2.5779	0.1152	500.4540	<.0001
NSeatB*SL60	1	2.2967	1.0224	5.0464	0.0247
NSeatB*SL65	1	2.7620	0.2926	89.1185	<.0001
NSeatB*SL70	1	2.5304	1.0277	6.0622	0.0138
SL15*SeatB	1	-0.6278	0.2265	7.6793	0.0056
SL20*SeatB	1	0.1396	0.1398	0.9967	0.3181
SL25*SeatB	1	0.1117	0.1053	1.1239	0.2891
SL30*SeatB	1	0.4522	0.0685	43.6096	<.0001
SL35*SeatB	1	0.6294	0.0694	82.1627	<.0001
SL40*SeatB	1	0.7182	0.0744	93.0571	<.0001
SL45*SeatB	1	0.8504	0.0797	113.7513	<.0001
SL50*SeatB	1	1.1278	0.1051	115.1344	<.0001
SL55*SeatB	1	0.8356	0.0906	85.0501	<.0001
SL60*SeatB	1	1.5429	0.5861	6.9311	0.0085
SL65*SeatB	1	0.6939	0.2096	10.9609	0.0009
SL70*SeatB	1	1.7405	0.3871	20.2130	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	50.5	Somers' D	0.256
Percent Discordant	24.9	Gamma	0.340
Percent Tied	24.7	Tau-a	0.004
Pairs	2600520288	c	0.628

MODEL: Fatalities and Incapacitating Injuries, Cars in Rural Areas

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS_RURAL_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	203997
Number of Observations Used	203997

Response Profile

Ordered Value	Inj Severe	Total Frequency
1	1	4839
2	0	199158

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	45773.538	42783.026
SC	45783.764	43038.672
-2 Log L	45771.538	42733.026

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	3038.5123	24	<.0001
Score	4765.0427	24	<.0001
Wald	3594.7135	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.5911	0.0903	2587.4791	<.0001
SL15*NSeatB	1	0.2049	0.5879	0.1215	0.7274
NSeatB*SL20	1	0.8775	0.3690	5.6543	0.0174
NSeatB*SL25	1	0.5278	0.4215	1.5679	0.2105
NSeatB*SL30	1	1.4949	0.1415	111.6073	<.0001
NSeatB*SL35	1	1.5977	0.1427	125.3968	<.0001
NSeatB*SL40	1	2.1554	0.1206	319.4496	<.0001
NSeatB*SL45	1	2.1089	0.1120	354.8603	<.0001
NSeatB*SL50	1	2.4331	0.1279	362.0887	<.0001
NSeatB*SL55	1	2.4824	0.0965	661.6004	<.0001
NSeatB*SL60	1	2.2434	0.3040	54.4556	<.0001
NSeatB*SL65	1	2.5281	0.1565	261.0785	<.0001
NSeatB*SL70	1	2.8319	0.2307	150.6634	<.0001
SL15*SeatB	1	-1.4682	0.5849	6.3017	0.0121
SL20*SeatB	1	-0.0332	0.2669	0.0155	0.9009
SL25*SeatB	1	-0.4545	0.2743	2.7448	0.0976
SL30*SeatB	1	0.0178	0.1250	0.0202	0.8869
SL35*SeatB	1	0.0538	0.1240	0.1882	0.6645
SL40*SeatB	1	0.5003	0.1061	22.2378	<.0001
SL45*SeatB	1	0.5039	0.1030	23.9321	<.0001
SL50*SeatB	1	0.6906	0.1130	37.3651	<.0001
SL55*SeatB	1	0.7230	0.0942	58.9641	<.0001
SL60*SeatB	1	0.5294	0.2174	5.9279	0.0149
SL65*SeatB	1	0.4564	0.1247	13.3827	0.0003
SL70*SeatB	1	0.4893	0.1676	8.5262	0.0035

Association of Predicted Probabilities and Observed Responses

Percent Concordant	59.6	Somers' D	0.362
Percent Discordant	23.3	Gamma	0.437
Percent Tied	17.1	Tau-a	0.017
Pairs	963725562	c	0.681

MODEL: Fatalities and Incapacitating Injuries, Cars on County Roads

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_COUNTY_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	88460
Number of Observations Used	88460

Response Profile

Ordered Value	Inj Severe	Total Frequency
1	1	2034
2	0	86426

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	19369.587	17903.284
SC	19378.977	18081.700
-2 Log L	19367.587	17865.284

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1502.3022	18	<.0001
Score	2333.1673	18	<.0001
Wald	1729.0661	18	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.1826	0.1346	964.9458	<.0001
SL15*NSeatB	1	0.2314	1.0185	0.0516	0.8203
NSeatB*SL20	1	0.9400	0.4753	3.9108	0.0480
NSeatB*SL25	1	0.3909	0.5992	0.4256	0.5142
NSeatB*SL30	1	1.2165	0.1888	41.5032	<.0001
NSeatB*SL35	1	1.4266	0.1792	63.3540	<.0001
NSeatB*SL40	1	1.8210	0.1629	124.9138	<.0001
NSeatB*SL45	1	1.7610	0.1570	125.8141	<.0001
NSeatB*SL50	1	2.1887	0.1894	133.5090	<.0001
NSeatB*SL55	1	2.0689	0.1452	203.0575	<.0001
SL15*SeatB	1	-1.6164	1.0105	2.5589	0.1097
SL20*SeatB	1	-0.5269	0.4028	1.7111	0.1908
SL25*SeatB	1	-0.8709	0.4024	4.6850	0.0304
SL30*SeatB	1	-0.6010	0.1777	11.4396	0.0007
SL35*SeatB	1	-0.3104	0.1710	3.2939	0.0695
SL40*SeatB	1	-0.0702	0.1539	0.2081	0.6483
SL45*SeatB	1	0.00981	0.1501	0.0043	0.9479
SL50*SeatB	1	0.0828	0.1790	0.2138	0.6438
SL55*SeatB	1	0.2498	0.1433	3.0399	0.0812

Association of Predicted Probabilities and Observed Responses

Percent Concordant	62.3	Somers' D	0.403
Percent Discordant	21.9	Gamma	0.479
Percent Tied	15.8	Tau-a	0.018
Pairs	175790484	c	0.702

MODEL: Fatalities and Incapacitating Injuries, Cars on Interstate Roads

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The LOGISTIC Procedure

Model Information

Data Set	W.CARS_INTERSTATE_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	39776
Number of Observations Used	39776

Response Profile

Ordered Value	Inj Severe	Total Frequency
1	1	544
2	0	39232

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	5752.298	5319.649
SC	5760.889	5379.786
-2 Log L	5750.298	5305.649

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	444.6485	6	<.0001
Score	893.4476	6	<.0001
Wald	572.3589	6	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.9008	0.1329	1358.9744	<.0001
SL55*NSeatB	1	2.0221	0.1863	117.8090	<.0001
NSeatB*SL65	1	2.7448	0.1793	234.2351	<.0001
NSeatB*SL70	1	3.0848	0.2464	156.6872	<.0001
SL55*SeatB	1	-0.1017	0.1648	0.3805	0.5373
SL65*SeatB	1	0.6972	0.1552	20.1740	<.0001
SL70*SeatB	1	0.8446	0.1885	20.0821	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	56.1	Somers' D	0.393
Percent Discordant	16.8	Gamma	0.540
Percent Tied	27.2	Tau-a	0.011
Pairs	21342208	c	0.697

MODEL: Fatalities and Incapacitating Injuries, Cars on US and State Roads

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_STATE_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	176722
Number of Observations Used	176722

Response Profile

Ordered Value	Inj Severe	Total Frequency
1	1	3301
2	0	173421

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	32820.240	30955.323
SC	32830.322	31126.722
-2 Log L	32818.240	30921.323

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1896.9170	16	<.0001
Score	3126.3990	16	<.0001
Wald	2302.1710	16	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.6235	0.0958	2328.5351	<.0001
SL30*NSeatB	1	0.8152	0.1647	24.5123	<.0001
NSeatB*SL35	1	0.5824	0.1797	10.4990	0.0012
NSeatB*SL40	1	1.1264	0.1681	44.8963	<.0001
NSeatB*SL45	1	1.6451	0.1265	169.1007	<.0001
NSeatB*SL50	1	2.1385	0.1407	230.9669	<.0001
NSeatB*SL55	1	2.4579	0.1051	547.1595	<.0001
NSeatB*SL60	1	2.1980	0.3048	51.9997	<.0001
NSeatB*SL65	1	2.6086	0.7588	11.8166	0.0006
SL30*SeatB	1	-0.1541	0.1266	1.4798	0.2238
SL35*SeatB	1	-0.1909	0.1216	2.4665	0.1163
SL40*SeatB	1	0.1526	0.1224	1.5533	0.2126
SL45*SeatB	1	0.2289	0.1103	4.3020	0.0381
SL50*SeatB	1	0.6462	0.1159	31.0673	<.0001
SL55*SeatB	1	0.7904	0.1007	61.5887	<.0001
SL60*SeatB	1	0.5831	0.2198	7.0370	0.0080
SL65*SeatB	1	-0.7792	1.0068	0.5990	0.4390

Association of Predicted Probabilities and Observed Responses

Percent Concordant	59.2	Somers' D	0.357
Percent Discordant	23.5	Gamma	0.432
Percent Tied	17.3	Tau-a	0.013
Pairs	572462721	c	0.679

MODEL: Fatalities and Incapacitating Injuries, Trucks and Buses

The SAS System 08:15 Sunday, September 27, 2009 23

The LOGISTIC Procedure

Model Information

Data Set	W.HEAVY_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	69317
Number of Observations Used	69317

Response Profile

Ordered Value	Inj Severe	Total Frequency

1	1	414
2	0	68903

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	5067.362	4578.709
SC	5076.509	4807.370
-2 Log L	5065.362	4528.709

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	536.6535	24	<.0001
Score	1009.5006	24	<.0001
Wald	548.1200	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-6.6565	0.2775	575.2823	<.0001
SL15*NSeatB	1	1.3287	0.7612	3.0465	0.0809
NSeatB*SL20	1	0.5384	1.0389	0.2686	0.6043
NSeatB*SL25	1	1.7798	0.5278	11.3723	0.0007
NSeatB*SL30	1	2.1019	0.3383	38.6013	<.0001
NSeatB*SL35	1	1.9945	0.3933	25.7203	<.0001
NSeatB*SL40	1	2.4774	0.3939	39.5661	<.0001
NSeatB*SL45	1	2.9505	0.3412	74.7701	<.0001
NSeatB*SL50	1	2.4999	0.4713	28.1357	<.0001
NSeatB*SL55	1	3.3674	0.3008	125.3100	<.0001
NSeatB*SL60	1	4.0175	0.3653	120.9783	<.0001
NSeatB*SL65	1	4.1621	0.3445	145.9882	<.0001
NSeatB*SL70	1	3.3984	1.0562	10.3537	0.0013
SL15*SeatB	1	0.8892	0.6414	1.9221	0.1656
SL20*SeatB	1	-11.8575	302.2	0.0015	0.9687
SL25*SeatB	1	0.2613	0.5722	0.2085	0.6480
SL30*SeatB	1	-0.0454	0.4209	0.0117	0.9140
SL35*SeatB	1	0.4577	0.4007	1.3051	0.2533
SL40*SeatB	1	0.7238	0.4211	2.9546	0.0856
SL45*SeatB	1	0.8417	0.3738	5.0704	0.0243
SL50*SeatB	1	0.3865	0.5723	0.4561	0.4995

SL55*SeatB	1	1.5207	0.3020	25.3607	<.0001
SL60*SeatB	1	1.8343	0.3426	28.6739	<.0001
SL65*SeatB	1	1.8660	0.3426	29.6718	<.0001
SL70*SeatB	1	2.4745	0.5752	18.5076	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	73.0	Somers' D	0.562
Percent Discordant	16.8	Gamma	0.627
Percent Tied	10.3	Tau-a	0.007
Pairs	28525842	c	0.781

MODEL: Fatalities and Incapacitating Injuries, Vans, Pickups, and SUVs

The LOGISTIC Procedure

Model Information

Data Set	W.MEDIUM_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	498583
Number of Observations Used	498583

Response Profile

Ordered Value	Inj Severe	Total Frequency
1	1	5579
2	0	493004

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	61227.560	56182.627
SC	61238.680	56460.615
-2 Log L	61225.560	56132.627

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	5092.9333	24	<.0001
Score	8747.1093	24	<.0001
Wald	5694.7056	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-5.4850	0.0665	6801.0805	<.0001
SL15*NSeatB	1	0.4810	0.2972	2.6201	0.1055
NSeatB*SL20	1	0.9358	0.2046	20.9237	<.0001
NSeatB*SL25	1	0.9567	0.1688	32.1288	<.0001
NSeatB*SL30	1	1.4575	0.0844	298.4993	<.0001
NSeatB*SL35	1	1.6794	0.0918	334.4567	<.0001
NSeatB*SL40	1	2.0867	0.0911	524.9695	<.0001
NSeatB*SL45	1	2.1949	0.0885	615.6959	<.0001
NSeatB*SL50	1	2.7110	0.1013	716.2672	<.0001
NSeatB*SL55	1	2.8183	0.0736	1465.0918	<.0001
NSeatB*SL60	1	2.7872	0.2942	89.7825	<.0001
NSeatB*SL65	1	3.4837	0.1185	864.1911	<.0001
NSeatB*SL70	1	3.7922	0.1737	476.7638	<.0001
SL15*SeatB	1	-1.8638	0.5045	13.6486	0.0002
SL20*SeatB	1	-0.7116	0.2517	7.9908	0.0047
SL25*SeatB	1	-0.4940	0.1649	8.9678	0.0027
SL30*SeatB	1	0.1527	0.0831	3.3796	0.0660
SL35*SeatB	1	0.2816	0.0852	10.9318	0.0009
SL40*SeatB	1	0.4928	0.0866	32.4166	<.0001
SL45*SeatB	1	0.6458	0.0868	55.3599	<.0001
SL50*SeatB	1	1.1301	0.0985	131.6887	<.0001
SL55*SeatB	1	1.0684	0.0756	199.8088	<.0001
SL60*SeatB	1	0.9998	0.2867	12.1587	0.0005
SL65*SeatB	1	1.2665	0.1123	127.2427	<.0001
SL70*SeatB	1	1.5266	0.1677	82.8678	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	66.9	Somers' D	0.469
Percent Discordant	20.0	Gamma	0.540
Percent Tied	13.2	Tau-a	0.010
Pairs	2750469316	c	0.735

MODEL: Fatalities and Incapacitating Injuries, Cars, Linked Data

The LOGISTIC Procedure

Model Information

Data Set	W.CARS_LINKED_SEVERE
Response Variable	InjSevere
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	79448
Number of Observations Used	79448

Response Profile

Ordered Value	Inj Severe	Total Frequency
1	1	2741
2	0	76707

Probability modeled is InjSevere=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	23845.015	22554.646
SC	23854.298	22786.718
-2 Log L	23843.015	22504.646

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	1338.3684	24	<.0001
Score	2015.9638	24	<.0001
Wald	1546.0798	24	<.0001

The LOGISTIC Procedure

Analysis of Maximum Likelihood Estimates

Parameter	DF	Standard Estimate	Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-4.1478	0.1062	1524.6881	<.0001
SL15*NSeatB	1	0.4589	0.5172	0.7872	0.3749
NSeatB*SL20	1	0.7979	0.3751	4.5258	0.0334
NSeatB*SL25	1	0.7954	0.2919	7.4245	0.0064
NSeatB*SL30	1	1.2409	0.1378	81.1265	<.0001
NSeatB*SL35	1	1.2304	0.1569	61.4713	<.0001
NSeatB*SL40	1	1.8060	0.1532	139.0099	<.0001
NSeatB*SL45	1	1.9328	0.1500	166.1220	<.0001
NSeatB*SL50	1	2.4896	0.1804	190.4696	<.0001
NSeatB*SL55	1	2.6079	0.1226	452.7854	<.0001
NSeatB*SL60	1	2.8950	0.4147	48.7288	<.0001
NSeatB*SL65	1	2.1589	0.3142	47.2056	<.0001
NSeatB*SL70	1	2.5637	0.4024	40.5929	<.0001
SL15*SeatB	1	-0.5059	0.4237	1.4257	0.2325
SL20*SeatB	1	-0.5145	0.3088	2.7758	0.0957
SL25*SeatB	1	-0.1108	0.1949	0.3232	0.5697
SL30*SeatB	1	0.2270	0.1207	3.5372	0.0600
SL35*SeatB	1	0.3756	0.1232	9.2869	0.0023
SL40*SeatB	1	0.5780	0.1258	21.1241	<.0001
SL45*SeatB	1	0.7406	0.1253	34.9419	<.0001
SL50*SeatB	1	0.8816	0.1475	35.6996	<.0001
SL55*SeatB	1	1.0732	0.1153	86.6730	<.0001
SL60*SeatB	1	1.5313	0.2799	29.9291	<.0001
SL65*SeatB	1	0.8172	0.1866	19.1780	<.0001
SL70*SeatB	1	1.9534	0.1977	97.6628	<.0001

Association of Predicted Probabilities and Observed Responses

Percent Concordant	62.7	Somers' D	0.349
Percent Discordant	27.8	Gamma	0.386
Percent Tied	9.5	Tau-a	0.023
Pairs	210253887	c	0.674